Vision Based Automatic Toll Tax Collection System using Wireless Technology and Image Processing

Submitted in partial fulfillment of the requirements for the degree of

BACHELOR OF ENGINEERING

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CHAPTER 1: INTRODUCTION

Among the few things which characterize our major populated cities in our nation is the amazing local transport system, which mainly compromises of the Railways and equally important land transportation systems which regulates the proper functioning of the local trains almost round the clock. Taking into consideration the large amount of traffic commuting everyday on roads the land transportation system is responsible for safe and sound transportation of the people of this perennially busy city which never sleeps. We have come to announce end traffic jams, an end gridlock, those who navigate congested roads will be pleased to learn, and will soon thing be past. All roads will free-flowing time, by the introduction of an innovative automatic toll tax control.

The highly instrument-based system is intended to perform functions like-- detecting vehicles and then data-formatting and transfer to the use. In short, the transport and traffic sectors would be the major gainers of the system. Whenever a vehicle passes through the toll gate, crucial data, the toll fee payments, and so on, are all recorded and, hence, are retrievable by the personnel concerned. These series of actions ensure the building up of a database and, second, the collection of toll fee, thus eliminating the chances of misuse or loss of revenue due to non-deposit collection of toll tax.

Each vehicle will be provided by an RFID tag containing a unique ID. This tag will continuously emit RF signals. When the vehicle will reach at the toll booth the RF receiver will detect these RF signals. The signals are amplified and are passed to microcontroller. This microcontroller will display the id on LCD. Now, with the help of PC interface unit the data collected is passed to PC through serial port. Software developed using C# .net will show all the details about the vehicle on the screen. Details like Number Plate, ID, Name, Type of vehicle, Total amount, Balance, time will be stored in the access database. Based on these details a report will be prepared. The bill for that particular vehicle will be also printed. Here additionally we are using Image Processing wherein the camera will capture the image and further processes it for matching.

1.1 About RFID

Radio frequency identification, or RFID, is a generic term for technologies that use radio waves to automatically identify people or objects. There are several methods of identification, but the most common is to store a serial number that identifies a person or object, and perhaps other information, on a microchip that is attached to an antenna (the chip and the antenna together are called an RFID transponder or an RFID tag). The antenna enables the chip to transmit the identification information to a reader. The reader converts the radio waves reflected back from the RFID tag into digital information that can then be passed on to computers that can make use of it.

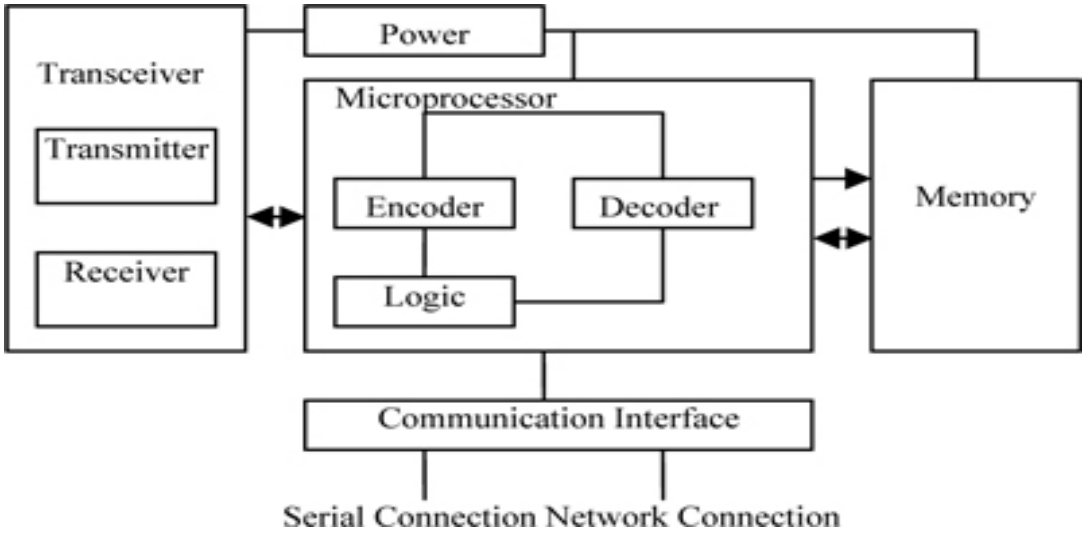

Fig 1.1 Block representation of RFID Transmitter and Receiver.

Radio-frequency identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by electromagnetic induction from magnetic fields produced near the reader. Some types collect energy from the interrogating radio waves and act as a passive transponder. Other types have a local power source such as a battery and may operate at hundreds of meters from the reader. Unlike a barcode, the tag does not necessarily need to be within line of sight of the reader and may be embedded in the tracked object. RFID is one method for Automatic Identification and Data Capture (AIDC).

RFID tags are used in many industries. For example, an RFID tag attached to an automobile during production can be used to track its progress through the assembly line; RFID-tagged pharmaceuticals can be tracked through warehouses; and implanting RFID microchips in livestock and pets allows positive identification of animals.

Microchips in RFID tags can be read-write or read-only. With read-write chips, you can add information to the tag or write over existing information when the tag is within range of a reader, or interrogator. Read-write tags usually have a serial number that can't be written over. Additional blocks of data can be used to store additional information about the items the tag is attached to. Some read-only microchips have information stored on them during the manufacturing process. The information on such chips can never been changed. Other tags can have a serial number written to it once and then that information can't be overwritten later.

1.2 About Image Processing:

In imaging science, image processing is any form of signal processing for which the input is an image, such as a photographer video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it.

Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to as imaging.

Closely related to image processing are computer graphics and computer vision. In computer graphics, images are manually made from physical models of objects, environments, and lighting, instead of being acquired (via imaging devices such as cameras) from natural scenes, as in most animated movies. Computer vision, on the other hand, is often considered high-level image processing out of which a machine/computer/software intends to decipher the physical contents of an image or a sequence of images (e.g., videos or 3D full-body magnetic resonance scans).

Basics of image editing:

Raster images are stored in a computer in the form of a grid of picture elements, or pixels. These pixels contain the image's color and brightness information. Image editors can change the pixels to enhance the image in many ways. The pixels can be changed as a group, or individually, by the sophisticated algorithms within the image editors. The domain of this article primarily refers to bitmap graphics editors, which are often used to alter photographs and other raster graphics. However, vector graphics software, such as Adobe Illustrator, CorelDraw, Xara Designer Pro or Inkscape, are used to create and modify vector images, which are stored as descriptions oflines,Bézier curves, and text instead of pixels. It is easier to rasterize a vector image than to vectorize a raster image; how to go about vectorising a raster image is the focus of much research in the field of computer vision. Vector images can be modified more easily, because they contain descriptions of the shapes for easy rearrangement. They are also scalable, being rasterizable at any resolution.

Automatic image Enhancement:

Camera or computer image editing programs often offer basic automatic image enhancement features that correct color hue and brightness imbalances as well as other image editing features, such as red eye removal, sharpness adjustments, zoom features and automatic cropping. These are called automatic because generally they happen without user interaction or are offered with one click of a button or mouse button or by selecting an option from a menu. Additionally, some automatic editing features offer a combination of editing actions with little or no user interaction.

Histogram:

Image editors have provisions to create an image histogram of the image being edited. The histogram plots the number of pixels in the image (vertical axis) with a particular brightness value (horizontal axis). Algorithms in the digital editor allow the user to visually adjust the brightness value of each pixel and to dynamically display the results as adjustments are made. Improvements in picture brightness and contrast can thus be obtained.

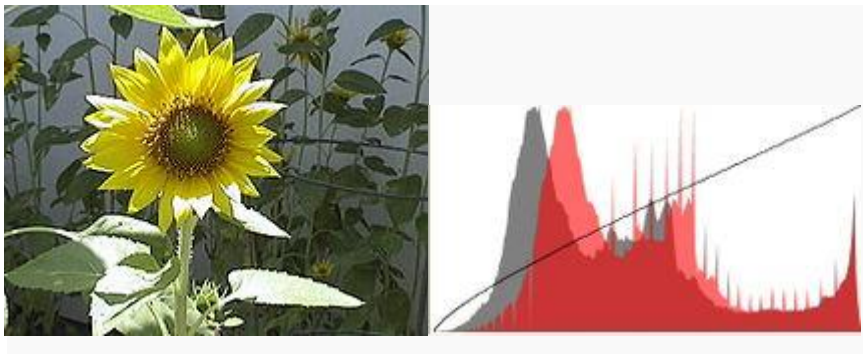

Fig 1.2. Image representation in Histogram format

Noise reduction:

Image editors may feature a number of algorithms which can add or remove noise in an image. Some JPEG artifacts can be removed; dust and scratches can be removed and an image can be de-speckled. Noise reduction merely estimates the state of the scene without the noise and is not a substitute for obtaining a "cleaner" image. Excessive noise reduction leads to a loss of detail, and its application is hence subject to a trade-off between the undesirability of the noise itself and that of the reduction artifacts.

Removal of unwanted elements:

Most image editors can be used to remove unwanted branches, etc., using a "clone" tool. Removing these distracting elements draws focus to the subject, improving overall composition.

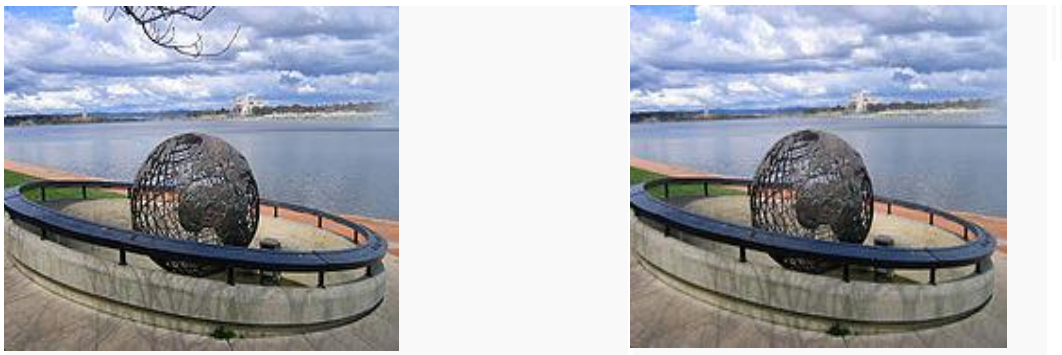

Fig 1.3. Removal of unwanted elements from imaging

1.3. Block Diagram of System:

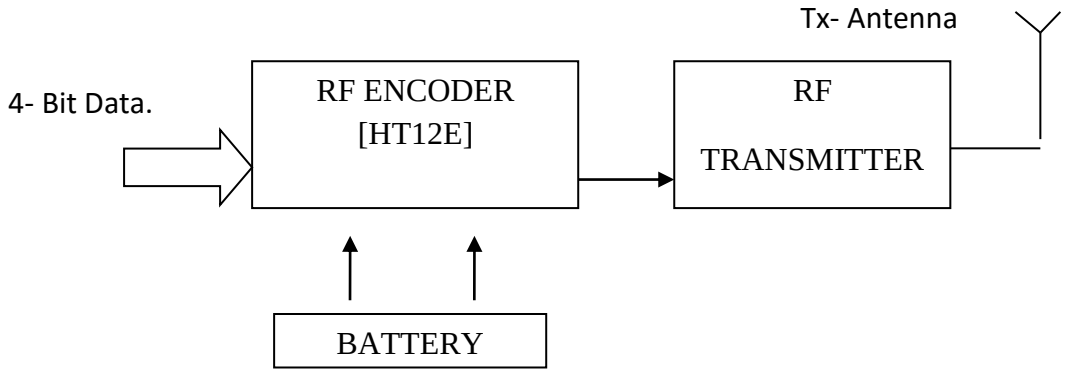

Fig. 1.4.Transmitter Section

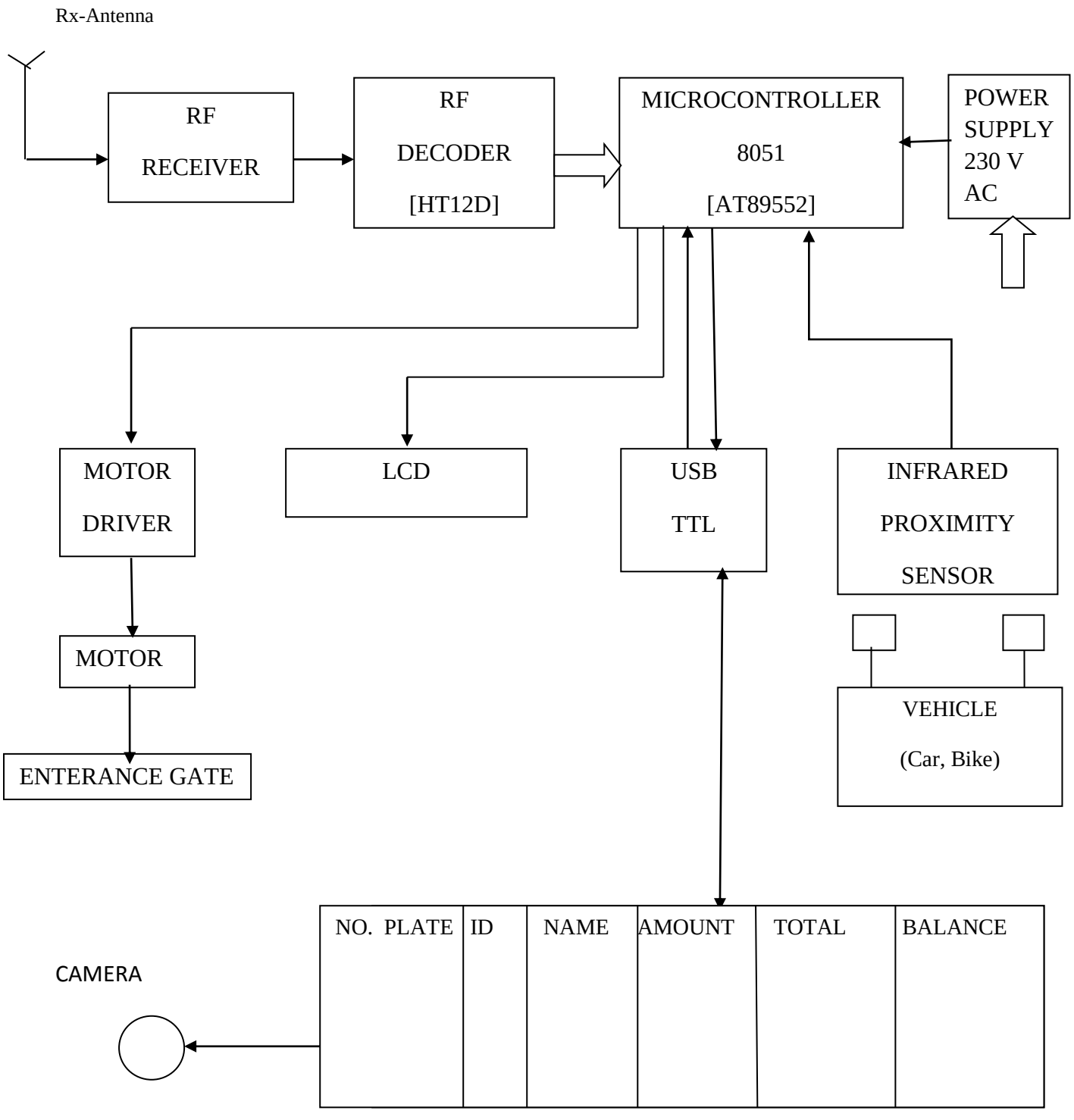

Fig. 1.4 Receiver Section

Each vehicle will be provided by an RFID tag containing a unique ID. This tag will continuously emit RF signals. When the vehicle will reach at the toll booth the RF receiver will detect these RF signals. The signals are amplified and are passed to microcontroller. This microcontroller will display the id on LCD. Now, with the help of PC interface unit the data collected is passed to PC through serial port. Software developed using C# .net will show all the details about the vehicle on the screen. Details like Number Plate, ID, Name, Type of vehicle, Total amount, Balance, time will be stored in the access database. Based on these details a report will be prepared. Here additionally we are using Image Processing wherein the camera will process the image of the number plate which will then be operated by image processing and will be saved as Number plate of the vehicle in the database.

1.4 Explanation of each Block:

The following are the brief explanations of the working principle of the various major blocks or sections used in the system.

- **RF Encoder HT12E:**

This unit is used to encode the 4-bit data before transmitting it in the communication channel. Basically it generates a serial bit stream of the parallel input data bits. It then sends data stream to RF transmitter unit.
This unit requires +5V to 12V DC for it proper operation.

- **RF Transmitter:**

This unit performs very significant roll i.e. it is responsible for the modulation (ASK, CF-434MHz) of the message or data to be transferred. Once the data is modulated then is transmitted or launched in Air by the help of the antenna. The baud rate is generally 1200bps and the range will be up to 100 ft.

- **RF Decoder HT12D:**

This unit is used to decode the 4-bit after receiving it from the RF Receiver unit. Basically it generates a parallel data from the serial incoming bit stream.

- **RF Receiver:**

This unit performs very significant roll i.e. it is responsible for the demodulation of the message or data after reception from air. This section is internally constructed with Amplifier unit, Filter unit, Peak Detector, Sample and Hold circuit and Level Shifter.

- **Power Supply:**

This unit will supply the various voltage requirements of each unit. This will be consists of transformer, rectifier, filter and regulator. The rectifier used here will be Bridge Rectifier. It will convert 230VAC into desired 5V/12V DC.

- **Microcontroller:**

This unit is the heart of the complete system. It is actually responsible for all the process being executed. It will monitor & control all the peripheral devices or components connected in the system. In short we can say that the complete intelligence of the project resides in the software code embedded in the Microcontroller.

The controller here user will be of 8051 family. The code will be written in Embedded C and will be burned or programmed into the code memory using a programmer.

This unit requires +5VDC for it proper operation.

- **LCD 16x2:**

It is called Liquid Crystal Display. We are going to use 16x2 character LCD. This will be connected to microcontroller. The job of LCD will be to display all the system generated messages coming from the controller. LCD will provide interactive user interface. This unit requires +5VDC for it proper operation.

- **USB TTL:**

A USB adapter is a type of protocol converter which is used for converting USB data signals to and from other communications standards. Commonly, USB adaptors are used to convert USB data to standard serial port data and vice versa. Most commonly the USB data signals are converted to either RS232, RS485, RS422 or TTL serial data. The older serial RS423 protocol is rarely used anymore, so USB to RS423 adapters are less common.

- **IR SENSOR:**

It is an infrared sensor used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion.

- **Motor Driver Circuit:**

A motor controller is a device or group of devices that serves to govern in some predetermined manner the performance of an electric motor. A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults. Every electric motor has to have some sort of controller. The motor controller will have differing features and complexity depending on the task that the motor will be performing. The simplest case is a switch to connect a motor to a power source, such as in small appliances or power tools. The switch may be manually operated or may be a relay or contactor connected to some form of sensor to automatically start and stop the motor. The switch may have several positions to select different connections of the motor. This may allow reduced-voltage starting of the motor, reversing control or selection of multiple speeds. Overload and over current protection may be omitted in very small motor controllers, which rely on the supplying circuit to have over current protection.

CHAPTER 2: LITERATURESURVEY

2.1 Automatic Vehicle Registration System for Tollbooths: {978-1-4577-0787-2/11/$26.00 ©2011 IEEE}

Abstract: With the advancement in computation, the era of automatic systems is rapidly taking over. Image processing is an essential tool being widely used in effective solutions concerning such systems. In our paper entitled "Automatic Vehicle Registration System for Tollbooths", we propose the use of image processing techniques for optimal character recognition in a license plate. We have proposed an effective algorithm to extract the digits from the license plate of a vehicle which can be used to fully automatize the access system at the barrier gate. The algorithm accounts for various anomalies in the system which may include movements at the gates and so on. The system proposed by us for calculation of tariff using the different image processing techniques has also been explained in detail. Its advantages over conventional system include low installation and maintenance cost amongst others.

System Design:

To implement the Automatic Vehicle Registration System, two cameras are used. The first camera will take the image of the entire object from above, thereby helping in deciphering the size of the object. The tariff calculations are made accordingly. The second camera will take the picture of the license number plate and series of process will lead to recognition. As a part of pre-processing procedure, brightness correction is done with the help of histogram equalization and disk filter with radius 5is used to eliminate the noise. The image thus obtained is segmented with the help of adaptive thresh holding method.Figure.1 shows the overview of the system. We hereby propose an algorithm (Algorithm 1, given below) to extract the number from the license plate. The structure of the algorithm and its flow chart has been mentioned below in Figure. 2

Algorithm 1:

1. From the segmented image, separate all connected components having pixel value greater than or equal to Po; where Po is the design parameter.

2. Sort the each block segments in their descending order.

3. a)Within every connected component, search if an object exists or not. Connected component analysis can be used for the same with pixel value greater than or equal to P1.

b) If no object is found; discard the object and continue with next block.

c) Else count the number of components and let the count be K.

4. If C1 □ K □ C2, then the block is found to be of interest, and hence the extraction process is done, else it is discarded. C1 & C2 are design parameter that depends upon minimum and maximum word-length of license plate.

5. Repeat this process only until we find the required block.

Algorithm 2:

Character recognition is done using template mapping. In this image every character is compared with the database and

Correlation is found between the two. The data corresponding to maximum correlation is taken to be the character. For this purpose more efficient methods such as matching of Fourier coefficients using fast Fourier Transform or Neural Network can be employed for better result.

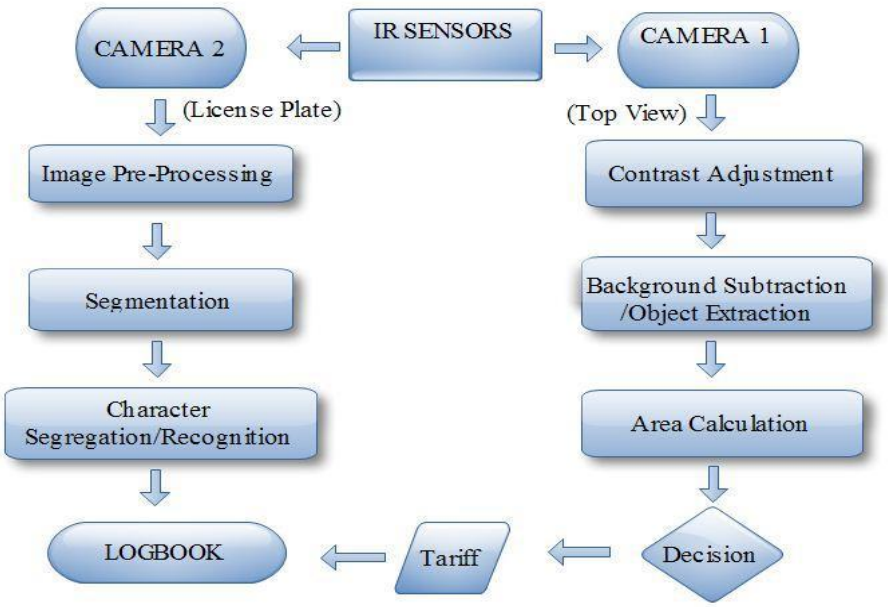

Fig 2.1.Overview of the System

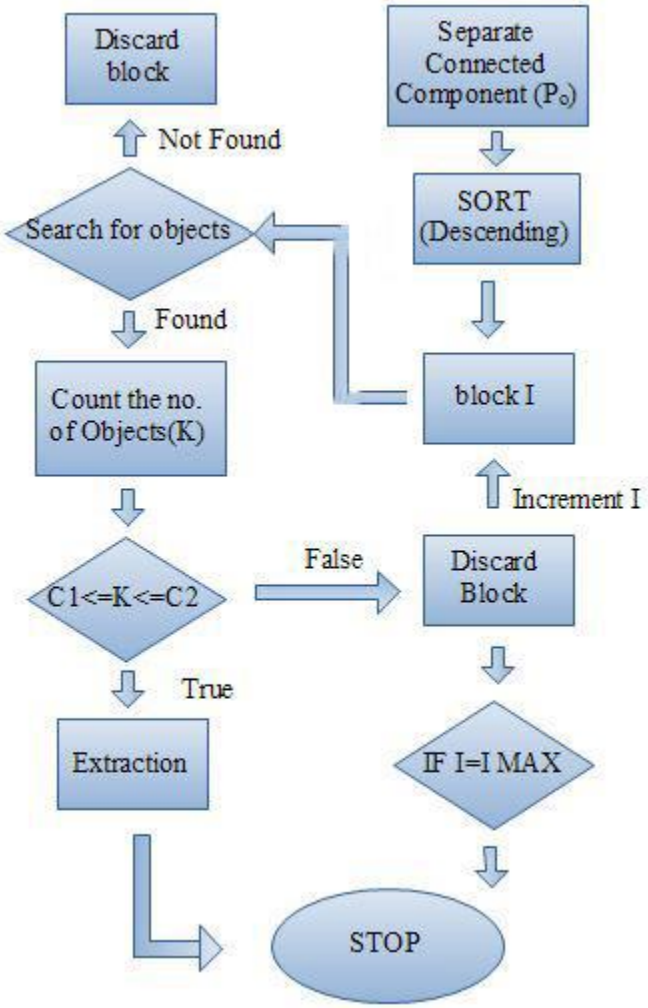

Fig 2.2. Calculation of Tariff

2.2 AUTOMATIC TOLL TAX COLLECTION USING RFID: IJRIM Volume 3, Issue 4 (April 2013) (ISSN 2231-4334): International Journal of Research in IT & Management 13

Abstract: Till today most of the toll taxes are collected manually in major parts of our country. We present the advanced version of toll tax collection using radio frequency under our research paper "Automatic Toll Tax Collection Using RFID". Electronic Toll Collection (ETC) is a technology that allows for electronic payment of tolls. An ETC system is able to determine if a vehicle is registered in a toll payment program, alerts enforcers of toll payment violations, and debits the participating account. Toll charges are generally based on mileage, maintenance requirements, or congestion levels. In this paper a system consists of a transponder (tag), reader/writer, antenna, and computer host. Under this every user will provided a unique card and password. When user comes under the range of RF card then he has to enter the valid password. If password matches then he will be allowed to enter else not. With the elimination of human interaction in the entire toll collection process, we can create a better ETC system. It can also significantly improve the efficiency of toll stations and the traffic abilities of the tollroad.

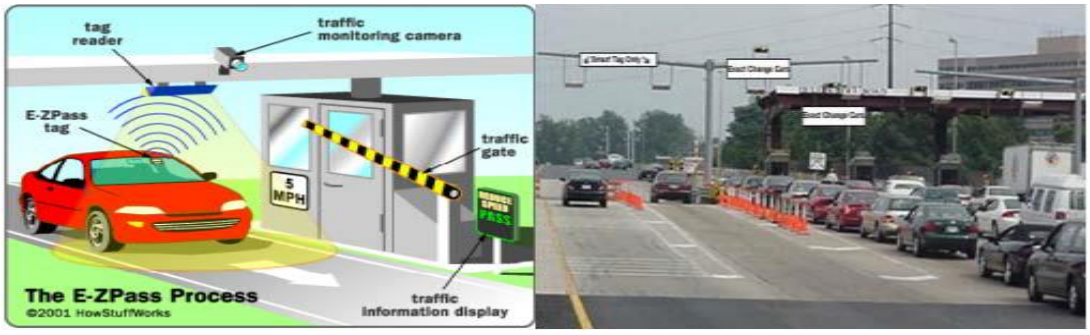

Fig 2.3 The Base Unit

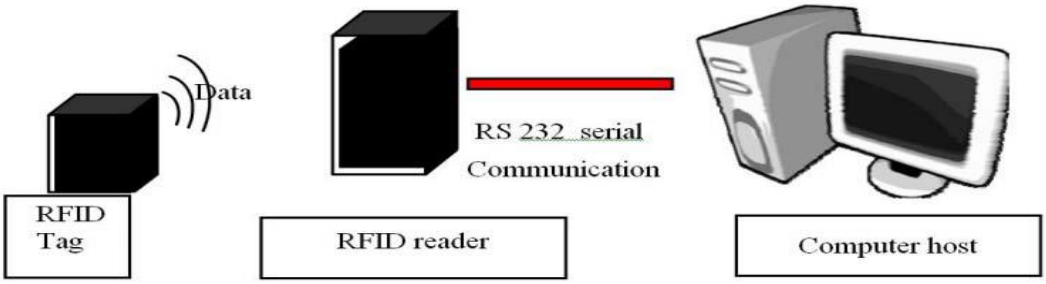

Fig 2.4 The Complete RFID system

Proposed System:

Each vehicle will be provided by an RF Transmission tag containing a unique ID. This unique ID can be assigned to the vehicle by authority body of country like we can have this ID as the vehicle's number. This tag will continuously emit RF signals. When the vehicle will reach at the toll booth the RF receiver will detect these RF signals. The signals are amplified and are passed to microcontroller. This microcontroller will display the id on LCD. Now, with the help of PC interface unit the data collected is passed to PC through serial port. Software developed will show all the details about the vehicle on the screen. Details like date, time, address and id will be stored in the access database. Based on these details are port will be prepared. Message of payment deduction, less balance or prepaid the account, etc. will be sent to vehicle owner by using GSM module present at toll booth

System (Hardware & software):

The basic block diagram in Fig.2 outlines the concept of Automatic Toll Tax collection using RFID. A dedicated GSM module is interfaced to the main server which will send the SMS to car owner for deduction in balance or less balance or deposited balance amounts. Camera is there which will take image of car. Here they are using BASCOM for programming. BASCOM-8051© is the Windows BASIC COMPILER for the 8051 family. It is designed to run on W95/W98/NT/W2000 and XP. It has Fast machine code instead of interpreted code. Compiled programs work with any 8051 up such as AT89C1051, AT89C2051, 8031, 8032, 8051, 8052, 80552, 80535 and 80537 Micro Processors. Special commands for LCD-displays, I2C chips and 1WIRE chips. We also used Visual Basic 6.0.

Working of the system:

The ATCSR works like this. Consumers use an electronic “tag”(transponder) about the size of an audio tape cassette which is attached to a vehicle’s inside windshield, as vehicle approaches a toll line, an RFID Reader in the lane reads the consumer’s vehicle and account information embedded in the tag. Using high frequency radio waves, the technology sends the information to an in-lane computer that checks the data against a database of valid tags and active accounts, deducts the appropriate toll from the customer’s account, and SMS will be sent to customer’s registered mobile number.SMS will have information regarding the net balance, deducted amount, date, time, etc. If the customer doesn’t have enough amount then car’s image will be taken by camera which is placed on the roadway or we can have buzzer for alarming it. Such customers can make to be in separate lane after crossing toll booth. ATCSR users set up a prepaid account which is debited for each use of an equipped roadway, bridge, or tunnel. (The tags are particularly advantageous to fleet operators who otherwise would have to advance cash to drivers for tolls or engage in time-consuming cash reimbursement.) Each tag contains an identification number, data identifying the issuing agency, tag type, a description of the vehicle, etc. The tag ID, agency ID, and tag type are encoded by the vendor and cannot be altered. The tag is based on read-write technology capable of storing highway entry and exit points for toll calculations in closed systems (i.e., where the toll is based on distance travelled). Vehicle gross weight for toll calculations based on weight or for checking maximum highway weight also can be obtained. Because the identity of ATCSR-equipped vehicles can bearded while vehicles are in motion (up to 90kmph), ATCSR promises to eliminate lengthy traffic backups at toll plazas, caused by motorists stopping to pay the toll manually.

2.3 ELECTRONIC TOLL COLLECTION SYSTEM USING PASSIVE RFID TECHNOLOGY: Journal of Theoretical and Applied Information Technology © 2005 - 2010 JATIT & LLS. All rights reserved.

Abstract: This paper focuses on an electronic toll collection (ETC) system using radio frequency identification (RFID) technology. Research on ETC has been around since 1992, during which RFID tags began to be widely used in vehicles to automate toll processes. The proposed RFID system uses tags that are mounted on the windshields of vehicles, through which information embedded on the tags are read by RFID readers, the proposed system eliminates the need for motorists and toll authorities to manually perform ticket payments and toll fee collections, respectively. Data information are also easily exchanged between the motorists and toll authorities, thereby enabling a more efficient toll collection by reducing traffic and eliminating possible human errors.

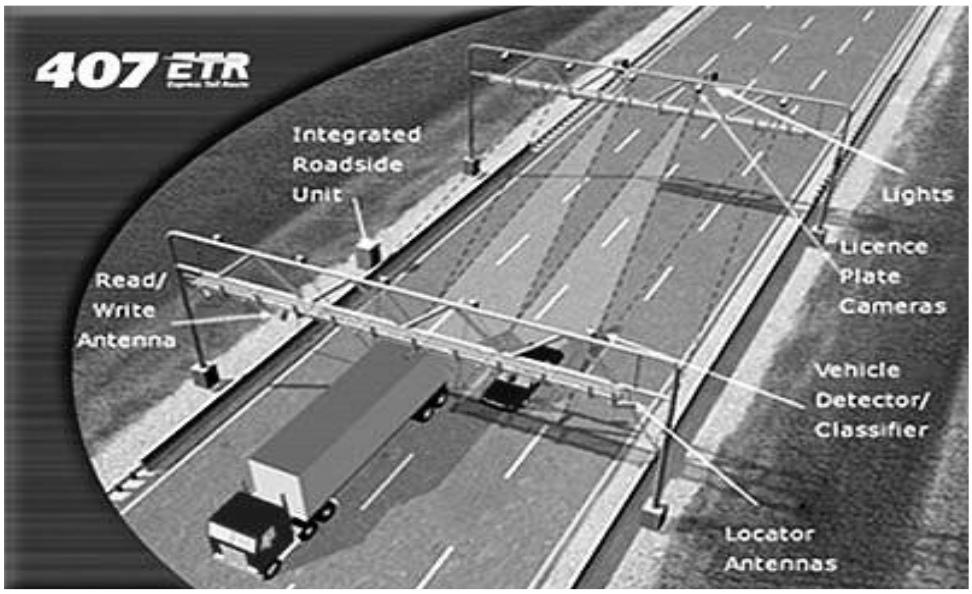

Figure 2.5 Canada's 407 ETR for ETC

Proposed system:

The main objective behind this proposal is to create a suitable ETC system to be implemented in Malaysia. The term "suitable" here refers to minimal changes in the current infrastructure with maximum increase in efficiency. The ETC system in Malaysia has been

introduced in the year 1994. It has evolved since then, and many changes have been done. The most recent ETC system consists of the Touch n Go and Smart TAG, referred to as the single ETC system in the country. This system uses IR technology, making it very vulnerable to failure. Other than that, users also have to bear the high cost of owning the two-piece tag required for this system. Thus, Malaysian highway authorities have been looking for alternatives, such as the multi-lane free-flow (MLFF) ETC system. However, this proposed system requires major changes in the infrastructure of the existing toll roads. In contrast, the ETC system proposed in this paper will require only minimal changes. Moreover, the existing toll booths could be re-used with only slight modifications

Instead of IR technology, the proposed ETC system will apply RFID technology. The concept is based on existing toll booths; however, human interaction is no longer required. The vehicles will be given a passive tag in the form of a sticker which could be affixed on the windshield, just like in the existing road tax system. Each time the vehicle passes the toll booth, the tag will be read and information will be transmitted to the main computer.

Road users also have the chance to choose either a prepaid or a post-paid tag. At the entrance point, the system will record the users' information with their preferred method (i.e., prepaid or post-paid). Then, at the end of the entrance point, the system will calculate the kilometre using this system, all problems related to manual toll fee collection will be eliminated, thereby achieving a higher efficiency rate per transaction. This is because this system requires no human interactions that could lead to cheating and human errors. In addition, compared with the existing system, in which motorists need to pay hundreds of Ringgits in order to own the two-piece tag required, the proposed system would only motorists to pay minimal fees as the cost of the whole system is not as high as the existing system. ters driven and then deduct payment straight from the tag (for prepaid users); if the balance is not enough, the barrier will still be lifted, but a warning email or an SMS will be sent to the owner. If the owner fails to pay the excessive amount, the tag will be barred. For the post-paid system, a bill will be sent to their respective homes at the end of every month. If the users fail to pay the amount, their tags will also be barred. The proposed system also considers the size issue. All the system requires is a tag the size of a sticker, which could be affixed on the windshield. In this system, the tag used is capable of withstanding all kinds of weather, and is much more durable compared with the one used in the existing system. The advantages of this proposed system is summarized as follows:

1. Higher efficiency in toll collection.

2.4RFID BASED TOLL COLLECTION SYSTEM: Rakhi Kalantri etal , (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 5 (2) 2014, 2582-2585 :ISSN :0975-9646

Abstract: The automated toll collection system using passive Radio Frequency Identification (RFID) tag emerges as a convincing solution to the manual toll collection method employed at tollgates. Time and efficiency are a matter of priority of present day. In order to overcome the major issues of vehicle congestion and time consumption RFID technology is used. RFID reader fixed at tollgate frame (or even a hand held reader at manual lane, in case RFID tagged vehicle enters manual toll paying lane) reads the tag attached to windshield of vehicle. The object detection sensor in the reader detects the approach of the incoming vehicle's tag and toll deduction takes place through a prepaid card assigned to the concerned RFID tag that belongs to the owners' account. This makes tollgate transaction more convenient for the public use.

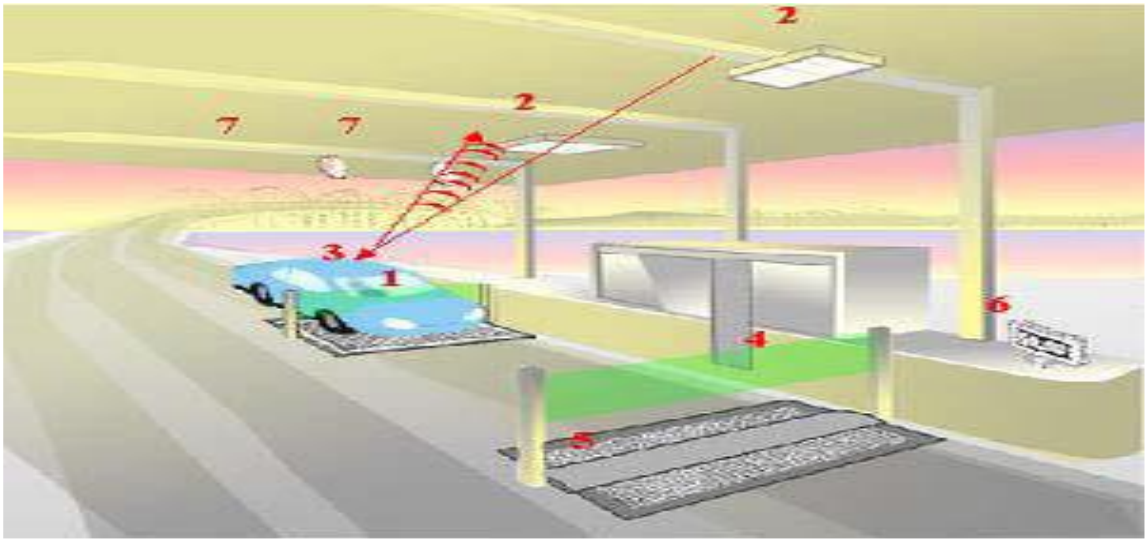

Figure 2.6 Implementation of RFID based Toll Collection System

Proposed System:

This project deals with the simplification of procedure followed by passengers to pay toll at toll collection booths, like making it automated, vehicle theft detection etc. All these activities are carried out using single smart card (RFID tag), thus saving the efforts of carrying money and records manually.

Automatic Toll Collection:

The RFID Readers mounted at toll booth will read the prepaid RFID tags fixed on vehicles windshield and automatically respective amount will be deducted. If the tag is removed from the wind shield then cameras fixed at two sites at toll plaza take snaps of the front and back number plate. Since every vehicle registration ID is linked to users account, toll can be deducted from the account bank directly.

Vehicle Theft Detection:

When vehicle is stolen the owner registers complaint on the website with its registration ID and unique RFID tag number. Now when stolen vehicle passes by the toll plaza, the tag fixed on it is matched with the stolen vehicle's tag in the database at the toll booth.

Signal Breaking Avoidance:

The vehicle ignoring the traffic signal will be detected by the RFID readers fixed at signal crossing and will be notified to the traffic police. This can be done efficiently and great accuracy.

Methodology:

Whenever any person buys a vehicle, one first needs to get this or her vehicle registered at the RTO office. RTO officials will not only assign a number plate to it but also will give a RFID enabled smart card or a tag. This card will have a unique ID feasible to use with that vehicle only. They will also create an account for the use of that particular smart card and maintain transaction history in database. User needs to deposit some minimum amount to this account. Every time a registered vehicle approaches the toll booth, first the Infrared sensors will detect the presence of the vehicle. It will in turn activate the RFID circuit to read the RFID enable smart card fixed on the windscreen of the vehicle. Transaction will begin, depending upon the balance available toll will be deducted directly or the vehicle will be directed towards another lane to pay tax manually. The software further updates the details in the Centralized database server. It also triggers mechanism to generate the bill and will be sent to user as a text message.

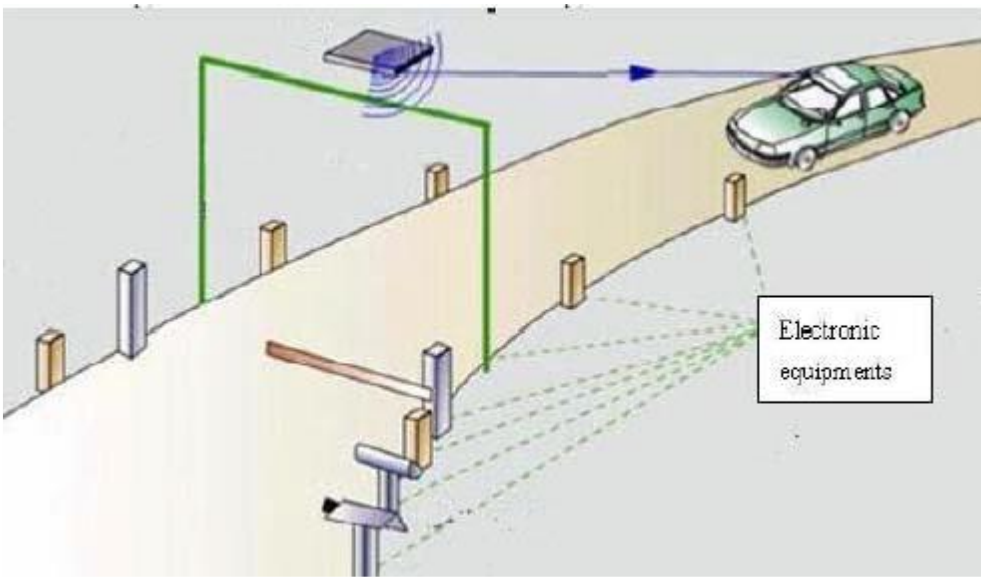

Fig 2.7 Working Model

On the other hand, whenever any vehicle owner registers a complaint to RTO office regarding theft respective entry is made in the database. Now any vehicle arriving at tollbooth with same ID as already present in stolen vehicle category will be easily identified as the ID assigned with it is unique. All the toll plazas will be connected to each other along with the centralized server in the form of LAN. Updates of any sort of transaction will be immediately updated to local database and centralized server.

2.5AUTOMATIC TOLL COLLECTION SYSTEM USING RFID

International Journal of Electrical and Electronics Research ISSN 2348-6988 (online) Vol. 2, Issue 2, pp: (67-72), Month: April - June 2014, Available at:

Abstract: ATCSR is an Automated Toll Collection System using RFID used for collecting tax automatically. In this we do the identification with the help of radio frequency. A vehicle will hold an RFID tag. This tag is nothing but unique identification number assigned. This will be assigned by RTO or traffic governing authority. In accordance with this number we will store, all basic information as well as the amount he has paid in advance for the TOLL collection. Reader will be strategically placed at toll collection centre. Whenever the vehicle passes the toll booth, the tax amount will be deducted from his prepaid balance. New balance will be updated. In case if one has insufficient balance, his updated balance will be negative one. To tackle this problem, we have camera on the way to capture the image of respective vehicle. As vehicles don't have to stop in a queue, this translates to reduced traffic congestion at toll plazas and helps in lower fuel consumption. This is very important advantage of this system.

Fig. 2.8 Proposed System Model

Working:

The E-Z Pass electronic toll collection works like this. Consumers use an electronic (Transponder) about the size of an audio tape cassette which is attached to a vehicle's inside

Windshield, as an equipped vehicle approaches a toll line, an antenna in the lane reads the Consumer's vehicle and account information embedded in the tag. Using high frequency radio waves, the technology sends the information to an in-lane computer that checks the data against a database of valid tags and active accounts, deducts the appropriate toll from the customer's account, and approves passage or raises a tollgate to allow the vehicle to pass through the toll plaza. Each commuter's tag emits a signal assigned specifically to him or her. This enables the commuter's use of all ETC equipped facilities to be tracked and logged. ETC users set up a prepaid account which is debited for each use of an equipped roadway, bridge, or tunnel. (The tags are particularly advantageous to fleet operators who otherwise would have to advance cash to drivers for tolls or engage in time-consuming cash reimbursement.) Each tag contains an identification number, data identifying the issuing agency, tag type, a description of the vehicle, and other agency-specific data. The tag ID, agency ID, and tag type are encoded by the vendor and cannot be altered.

The tag is based on read-write technology capable of storing highway entry and exit points for toll calculations in closed systems (i.e., where the toll is based on distance travelled). Vehicle gross weight for toll calculations based on weight or for checking maximum highway weight also can be obtained. Because the identity of ETC-equipped vehicles can be read while vehicles are in motion (up to 40 mph), ETC promises to eliminate lengthy traffic backups at toll plazas, caused by motorists stopping to pay the toll manually.

Technology used in ATCS:

RFID (Radio Frequency Identification) is an automatic identification method, relying on storing and remotely retrieving data using devices called RFID tags or transponders. An RFID tag is a small object that can be attached to or incorporated into a product, animal, or person. RFID tags contain silicon chips and antennas to enable them to receive and respond to radio-frequency queries from an RFID transceiver. Passive tags require no internal power source, whereas active tags require a power source.

The purpose of an RFID system is to enable data to be transmitted by a mobile device, called a tag, which is read by an RFID reader and processed according to the needs of a particular application. The data transmitted by the tag may provide identification or location information, or specifics about the product tagged, such as price, colour, date of purchase, etc.

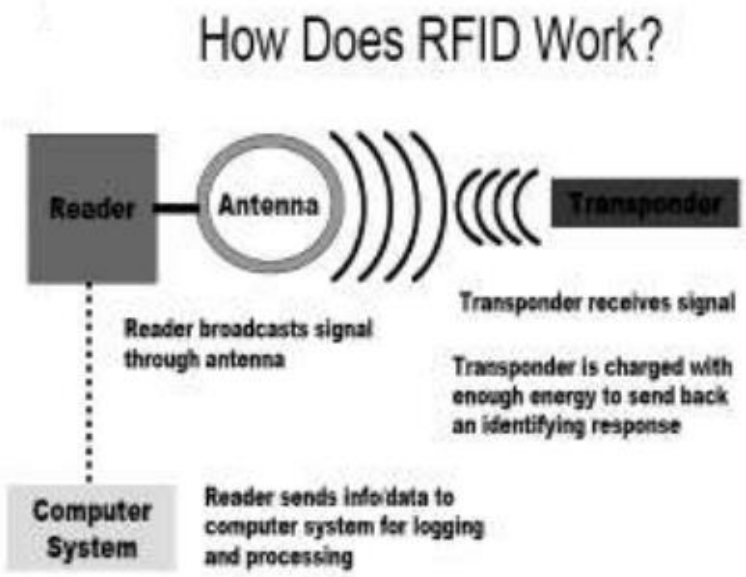

Fig 2.9 RFID Working

In a typical RFID system, individual objects are equipped with a small, inexpensive tag. The tag contains a transponder with a digital memory chip that is given a unique electronic product code. The interrogator, an antenna packaged with a transceiver and decoder, emits a signal activating the RFID tag so it can read and write data to it. When an RFID tag passes through the electromagnetic zone, it detects the reader's activation signal. The reader decodes the data encoded in the tag's integrated circuit (silicon chip) and the data is passed to the host computer.

2.6 NO QUEUE (UNINTERRUPTED) TOLL TAX COLLECTION SYSTEM

Abstract: Among the few things which characterize our glorious city of Mumbai is the amazing local transport system, which mainly compromises of the Railways and equally important ROAD TRANSPORTATION SYSTEMS which regulates the proper functioning of the local trains almost round the clock. Taking into consideration the large amount of traffic commuting everyday on roads the road transportation system is responsible for safe and sound transportation of the people of this perennially busy city which never sleeps. With the movement of inter-State vehicles and goods, there is rise in the number of toll roads and bridges. Which overall increases the load on highway roads. Hence scientific tracking and monitoring system becomes a need of the toll tax department. The proper collection of toll fees can generate a huge quantum of funds for the maintenance of aging bridges and the large road network. Hence to improve the toll tax collection system and to reduce the traffic at toll tax depots we will develop a system called No Queue Toll Tax Collection System.

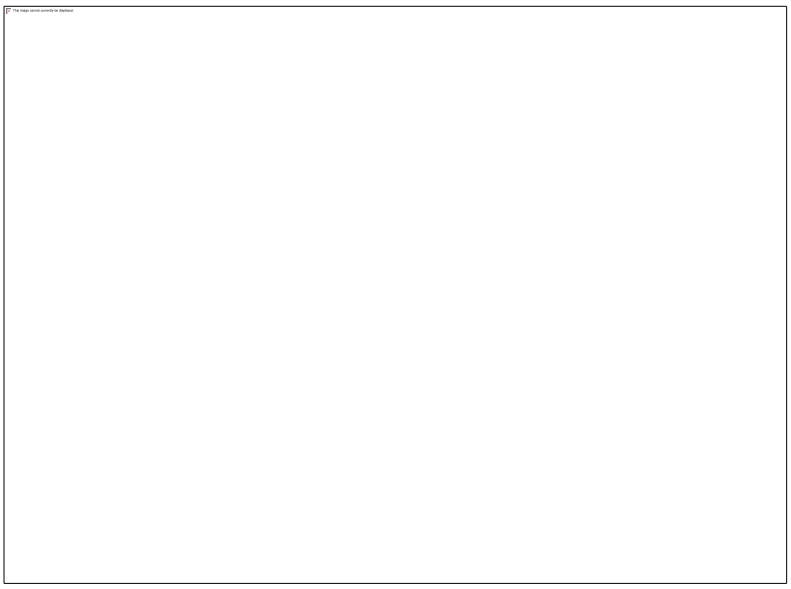

Fig 2.10 .Existing System

Proposed System:

Each vehicle will be provided by an RF TX tag containing a unique ID. This tag will continuously emit RF signals. When the vehicle will reach at the toll booth the RF receiver will detect these RF signals. The signals are amplified and are passed to microcontroller. This microcontroller will display the id on LCD. Now, with the help of PC interface unit the data collected is passed to PC through serial port. Software developed will show all the details about the vehicle on the screen. Details like date, time and id will be stored in the access database. Based on these details a report will be prepared. At the end of the month the system will print the detailed bill and the total amount of the toll tax for the month will also be printed. This bill will be sent to the user for payment.

The following are the major advantages over current system:-

- Automatic collection of toll tax.
- Free flow of traffic.
- Time saving.
- Record maintenance.
- Problems with pursuing toll evaders.

2.7 Automatic Toll Gate System Using Advanced RFID and GSM Technology, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 11, November 2014

Abstract: Most Electronic Toll Collection (ETC) systems around the world are implemented by DSRC (Dedicated Short Range Communication) technology. The concept proposed is of automatic toll tax payment system and the amount transaction information sends to the cell phone of the motorists through the GSM modem technology. It is an innovative technology for expressway network automatic toll collection solution. In this paper, the frame composing and working flow of the system is described and data information is also easily exchanged between the motorists and toll authorities, thereby enabling a more efficient toll collection by reducing traffic and eliminating possible human errors.

Proposed Method: The proposed method is to provide a fast and safe environment for toll collection and to automatically control the vehicle movements at the toll stations. The Capacitive Sensor used here to sense the vehicle size.IR sensor is used to detect the vehicle and the Gate models are used here to open and close while the vehicle is entering or exit in the Toll Tax unit. The RFID reader is used to read the tag of the vehicles. The Vehicle information is stored in the microcontroller based on the TAG number. Based on that number the Tax amount for that vehicle will automatically transfer to the toll gate system. And that cost information will be sent through GSM modem to a mobile phone of the owner. The status of the vehicle will be displayed in the LCD. The main objective behind this proposal is to create a suitable Automatic Toll Gate System to be implemented. This system uses IR technology, making it very vulnerable to failure. Other than that, users also have to bear the high cost of owning the two-piece tag required for this system. However, this proposed system requires major changes in the infrastructure of the existing toll roads.

Circuit Modules of the proposed RFID system:

An antenna used to scan the cards and a transceiver with a decoder to interpret the data. Transponder - the RFID tag are available in which the data has been programmed with information. The scanning antenna puts out radio-frequency signals in a relatively short range.

RFID Tag:

An RFID tag is a microchip combined with an antenna in a compact package; the packaging is structured to allow the RFID tag to be attached to an object to be tracked. "RFID" stands for Radio Frequency Identification. The tag's antenna picks up signals from an RFID reader or scanner and then returns the signal, usually with some additional data (like a unique serial number or other customized information). RFID tags can be very small - the size of a large rice grain. Others may be the size of a small paperback book. IR TRANSMITTER AND RECEIVER: The IR Transmitter Receiver gate we are using in our project to detect the exact location & position of the vehicle on the load cell plate. Because one problem with load cell plate is that it is unable to weigh the moving object. The IR transmitter is continuously emitting the IR rays towards the IR receiver. When the vehicle is going to come across the gate the rays are deflected from the vehicle & IR receiver doesn't get any signal. Here for IR transmitter we are using IR LED's. The IR transmitter we may design in our home by just connecting desired value of resistance in +ve arm & another is grounded.

The IR receiver has three pins i.e. 5V supply, GND. Line, signal line. GSM SERVICES: In radio spectrum is a limited resource shared by all users, a method must be devised to divide up the bandwidth among as many users as possible. The method chosen by GSM is a combination of Time- and Frequency-Division Multiple Access (TDMA/FDMA). The FDMA part involves the division by frequency of the (maximum) 25 MHz bandwidth into 124 carrier frequencies spaced 200 kHz apart. One or more carrier frequencies are assigned to each base station. Each of these carrier frequencies is then divided in time, using a TDMA scheme. The fundamental unit of time in this TDMA scheme is called a burst period and it lasts 15/26 ms (or approx. 0.577 ms). Eight burst periods are grouped into a TDMA frame (120/26 ms, or approx. 4.615 ms), which forms the basic unit for the definition of logical channels.

The MXE is a node that provides integrated voice, fax, and data messaging. Specifically, the MXE handles short message service, cell broadcast, voice mail, fax mail, e-mail, and notification. Mobile Service Node (MSN): The MSN is the node that handles the mobile intelligent network (IN) services. Gateway Mobile Services Switching Centre (GMSC): A gateway is a node used to interconnect two networks. The gateway is often implemented in an MSC. The MSC is then referred to as the GMSC.

2.8 Electronic toll collection technologies: A state of art review, Volume 4, Issue 7, July 2014 ISSN: 2277 128X

Abstract: This work covers the state of art of various existing electronic toll collection (ETC) technologies. Also, the present study covers the technical and economic aspects associated with these technologies. All technologies understudy are reviewed in context of their suitability for Indian roads. In this direction, the pros and cons are discussed and compared to determine the conflict in trade-offs among these technologies prior to implementation in India.

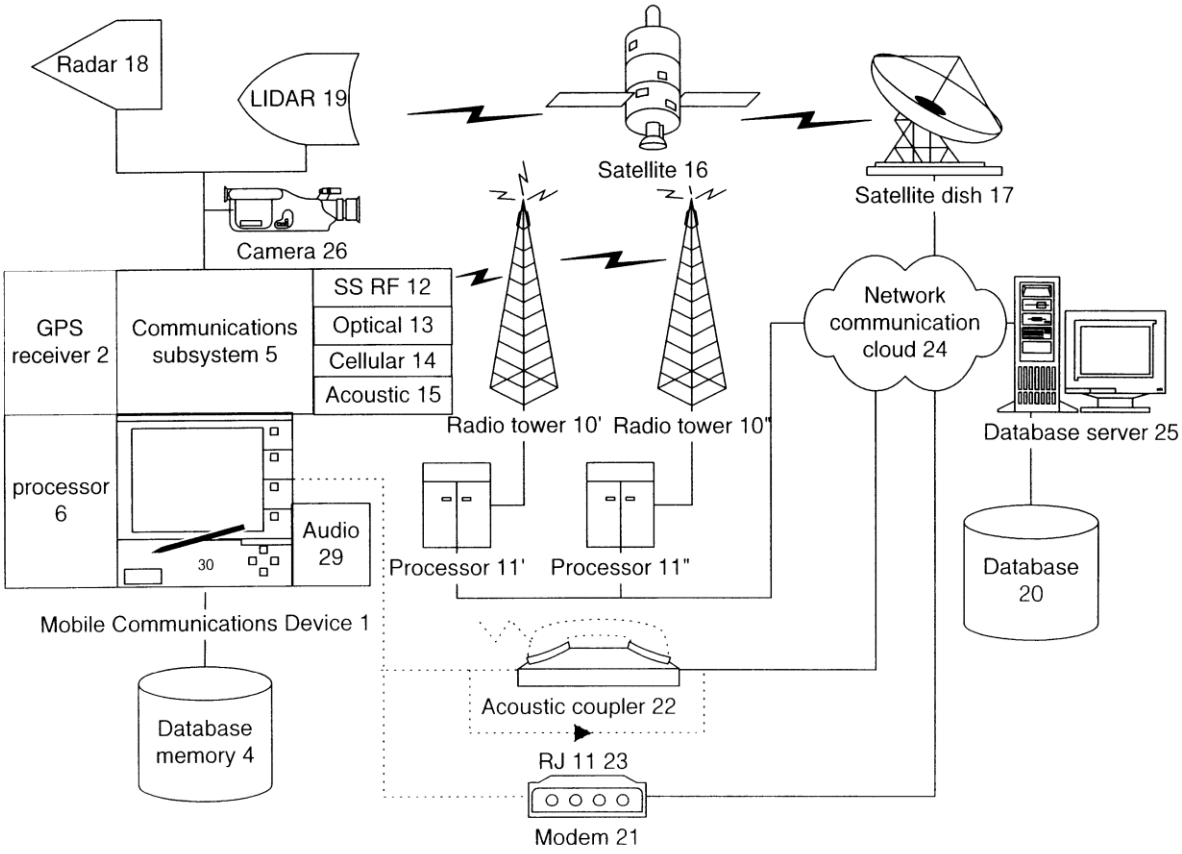

Fig2.11 Complex network for GPS-based ETC system

Discussion:

Present study has made it very clear that there are no clear trade-offs among the above mentioned technologies. Due to this, it becomes an onerous task to move further to decide the best option among the existing ones or to develop a newer technology. In such a state of ambiguity when one is not even able to choose the best among the existing alternative, there is no space for the question of adopting a hybrid technology. It also de motivate the policy makers to adopt newer advanced technologies as a single wrong decision can bring up loads of problems for coming generations with huge wastage of money and time. Therefore, it becomes essential to predict the best solution in terms of best alternative for such problems using a highly subjective decision making technique. In this context, we aim to figure out a solution by aid of Multiple Attribute Decision Making (MADM) techniques. A variety of methods are reported under MADM category. These methods include simple additive weighting (SAW), analytic hierarchy process (AHP), graph theory and matrix approach (GTMA) , VlseKriterijumska Optimisacija I Kompromisno Resenje (VIKOR), technique for order preference by similarity to ideal solution (TOPSIS) and many others. These have been successfully applied to various fields such as manufacturing processes, supply chain management social science decisions, financial decisions and engineering problems. MADM models are used to select best alternative from the large number of alternatives for a set of selection criteria. Moreover, these also tell about the degree of closeness in terms of rank index. The above mentioned MADM approaches work on crisp values of attributes. However, in case of selection of advanced technologies, most of the attributes/parameters depend on views of various decision makers (such as user, operators, government, distributors, technical and economy experts etc.). There are no clear boundaries among the views of these decision makers. The present study is one of the first efforts to pin point the issues concerned with selection of optimal ETC system in India. In future we hope to subjectively study and figure out the answer to the question raised by us in the present study.

2.9. RFID Based Toll Deduction System, I.J. Information Technology and Computer Science, 2012, 4, 40-46 published Online April 2012 in MECS (http://www.mecs-press.org/) DOI: 10.5815/ijitcs.2012.04.06

Abstract— In this research paper we examine RFID based toll deduction system and how to make more efficient and perfect. The vehicle will be equipped with a radio frequency (RF) tag which will detect RF Reader located in on toll plaza. The amount will then automatically deduct from the bank account. This research paper can be considered scalable to implement in motor vehicles used today.

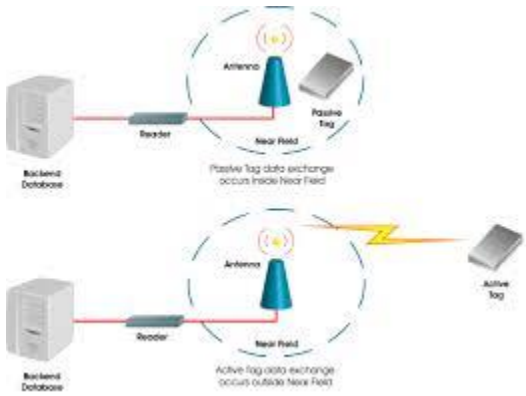

Fig 2.12 Process

RFID Tag Attributes

	Active RFID	Passive RFID
Tag Power Source	Internal to tag	Energy transferred using RF from reader
Tag Battery	Yes	No
Availability of power	Continuous	Only in field of reader
Required signal strength to Tag	Very Low	Very High
Range	Up to 100m	Up to 3-5m, usually less
Multi-tag reading	1000's of tags recognized – up to 100mph	Few hundred within 3m of reader
Data Storage	Up to 128Kb or read/write with sophisticated search and access	128 bytes of read/write

Fig 2.13 RFID Tag Attributes.

Design:

RFID tag can be installed with number plate; Mount your exterior license plate tag at the top of your front license plate with has faced upward readable position. Figure 3 gives a phenomenal design approach for the research purpose and concept. The Reader (Antenna) or interrogator receives data from the tag which placed on vehicle, reader can have an integrated antenna or the antenna can be separate. Reader is placed on the middle of toll deduction gate and it is connected to Central Server (backend database).

Middleware software: Middleware software connects reader and the Central server and the data coming from the tags stored in backend database. Middleware sits in the middle of the data flow of information between the reader and backend database of Central server.

2.10 AUTOMATED TOLL BOOTH AND TRACKING SYSTEM FOR THEFT VEHICLE

Abstract— In this research paper we examine the image & the respective information will be processing based toll collection system and how to make more efficient and perfect. On any toll both the vehicle has to stop for paying the toll. We are trying to develop a system that would pay the toll automatically and reduce the queue at the toll booth. In this system camera is used for capturing the image of the vehicle number plate. The captured image would be converted into the text using ANPR and the toll would be cut from the customer's account and then open the gate. Moreover in our system if a vehicle is stolen and an entry is being made in the central database by the police then if the vehicle passes through the toll both then silent alarm would buzz which would indicate the operator at the toll booth that the vehicle is a stolen vehicle. For the identification of the vehicles, the information of the vehicles is already stored on the central database. So captured number will be sent to the server received at the toll.

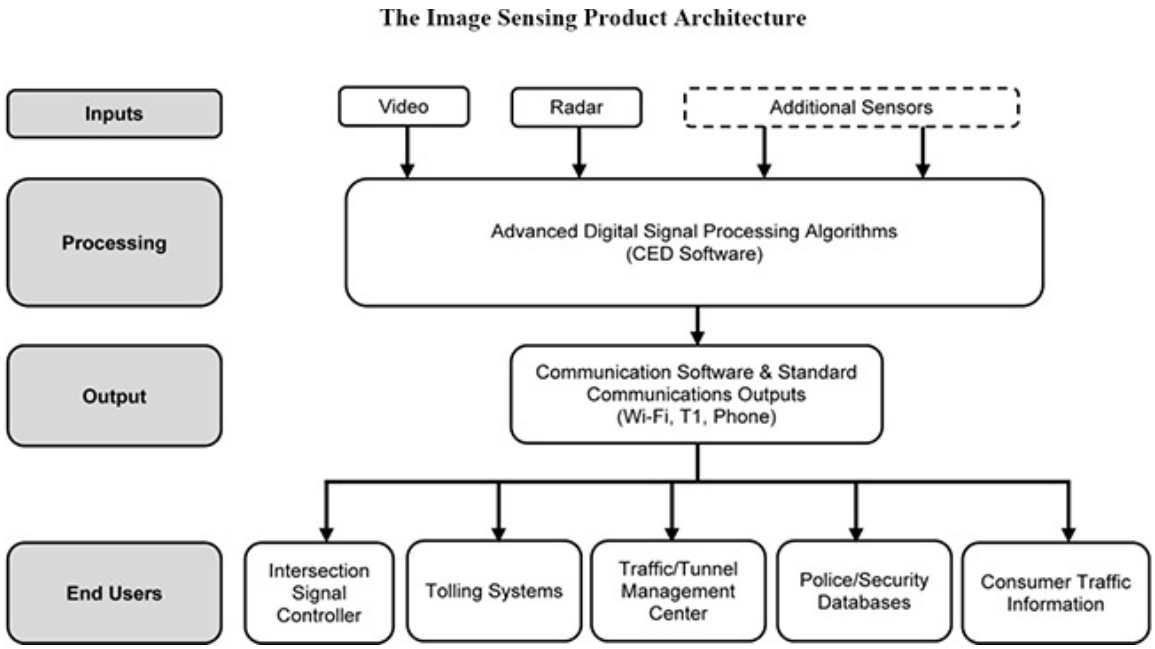

Fig 2.14 ANPR Flow for Toll Tax

System Design:

The process starts when a sensor detects the presence of a vehicle and signals the system camera to record an image of the passing vehicle. The image is passed on to a computer where software running, on the computer extracts the license plate number from the image. LPN (License plate number) can then be verified in a central database. If number valid for this system then LPN recorded in a database with other information such as vehicle number, time, balance, personal details. License plate numbers can also be further processed and be used to control other systems such as raising a gate. These toll systems are generally composed of four main components: Sensor used for vehicle detection,LPR Camera for capturing images, Computer with TOLL and Image processing software, Gate controlled system.

Software and Security:

Login with OTP (one time password) security: In proposed system as toll operator point of view provide OTP system. OTP is a password that is valid for only one login session. OTP generation algorithms typically make use of randomness. Any toll workers knows ID and password but when enter the private details for login then generate OTP and send to the toll operator register mobile and then login with OTP, ID and password. If all the details match then operator can login to the toll system. B. Toll operating software: When vehicle enter in the toll plaza then toll software automatically start. Shows in fig 4 in these application firstly get vehicle licence plate number then check if number is valid for these system then using TTV(text to voice) read number in a speaker for driver confirmation. Also check the balance in customer account and same time check licence number in stolen vehicle database.

CHAPTER 3: PROBLEM DEFINITION AND PROPOSED SOLUTION

3.1 Problem Definition:

- **Existing System**

There are two ways of collecting toll tax being in practise at present. First is the traditional manual method where one person collects the money and issues a receipt.

The other one is Smart Card system where the person needs to show the smart card to the system installed at the toll tax depot to open the barrier.

- **Drawbacks of Existing System**

Both the above mentioned method collecting toll tax is time consuming method. Chances of escaping the payment of toll tax are there. It leads to queuing up of following vehicles. Also there is heavy usage of paper as well which leads to high wastage .Also the present system will not be able to check the authentication of the vehicle driver, and hence there will be a possibility of theft.

3.2. Software:

3.2.1 Front End Development: Visual Studio 2010

For developing our front end of our system we have used Visual Studio 2010 by Microsoft.**Microsoft Visual Studio** is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs for Microsoft Windows, as well as web sites, web applications and web services. Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, and Windows Store and Microsoft Silver light. It can produce both native code and managed code.

Visual Studio includes a code editor supporting IntelliSense as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger. Other built-in tools include a forms designer for building GUI applications, web designer, class designer, and database schema designer. It accepts plug-ins that enhance the functionality at almost every level—including adding support for source-control systems (like Subversion) and adding new toolsets like editors and visual designers for domain-specific languages or toolsets for other aspects of the software development lifecycle (like the Team Foundation Server client: Team Explorer).

Visual Studio supports different programming languages and allows the code editor and debugger to support (to varying degrees) nearly any programming language, provided a language-specific service exists. Built-in languages include C,C++and C++/CLI (via Visual C++), VB.NET (via Visual Basic .NET), C# (via Visual C#), and F# .Support for other languages such as M, Python, and Ruby among others is available via language services installed separately. It also supports XML/XSLT, HTML/XHTML, JavaScript and CSS.

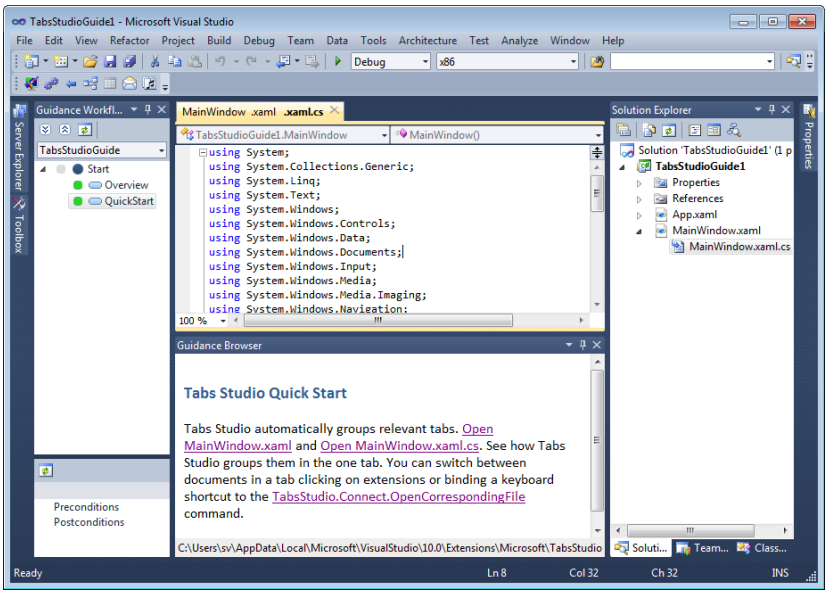

Fig 3.1 Microsoft Visual Studio 2010 View 1

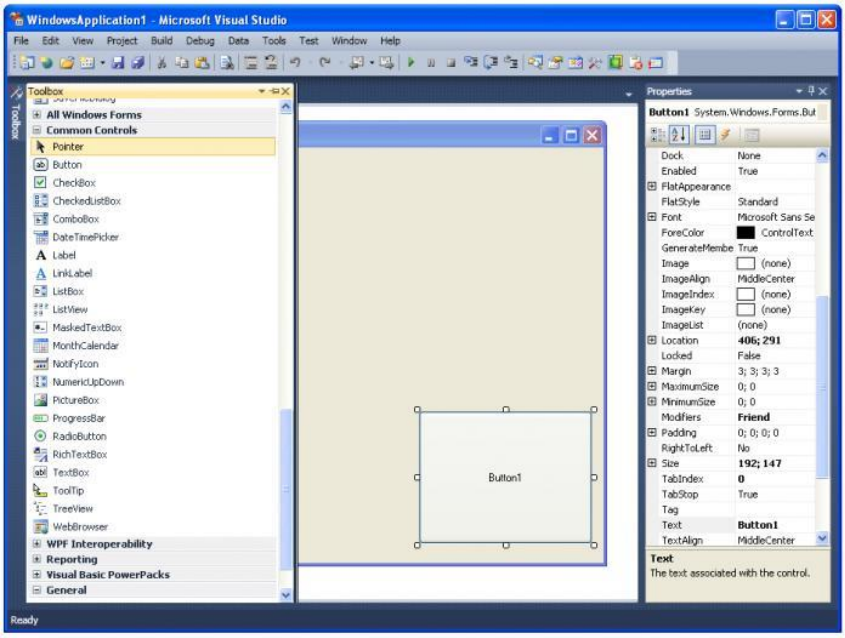

Fig 3.2 Microsoft Visual Studio 2010 View

3.2.2 Open CV:

Fig 3.3 OpenCV Logo

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code.

The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc. OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 7 million. The library is used extensively in companies, research groups and by governmental bodies.

Along with well-established companies like Google, Yahoo, Microsoft, Intel, IBM, Sony, Honda, Toyota that employ the library, there are many startups such as Applied Minds, Video Surf, and Zeitera, that make extensive use of OpenCV. OpenCV's deployed uses span the range from stitching street view images together, detecting intrusions in surveillance video in Israel, monitoring mine equipment in China, helping robots navigate and pick up objects at Willow Garage, detection of swimming pool drowning accidents in Europe, running interactive art in Spain and New York, checking runways for debris in Turkey, inspecting labels on products in factories around the world on to rapid face detection in Japan.

It has C++, C, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS. OpenCV leans mostly towards real-time vision applications and takes advantage of MMX and SSE instructions when available. A full-featured CUDA and OpenCL interfaces are being actively developed right now. There are over 500 algorithms and about 10 times as many functions that compose or support those algorithms. OpenCV is written natively in C++ and has a template interface that works seamlessly with STL containers.

3.2.3 MySQL:

We have used MySQL for the back end of the system. **MySQL** also called as My Sequel and is (as of July 2013) the world's second most widely used relational database management system (RDBMS) and most widely used open-source RDBMS. It is named after co-founder Michael Widenius's daughter, My the SQL acronym stands for Structured Query Language. The MySQL development project has made its source code available under the terms of the GNU General Public License, as well as under a variety of proprietary agreements. MySQL was owned and sponsored by a single for-profit firm, the Swedish company MySQL AB, now owned by Oracle Corporation.

MySQL is a popular choice of database for use in web applications, and is a central component of the widely used LAMP open source web application software stack (and other 'AMP' stacks). LAMP is an acronym for "Linux, Apache, MySQL, Perl/PHP/Python." Free-software-open source projects that require a full-featured database management system often use MySQL.

Fig 3.4 MySQL Logo

3.3Proposed Solution:

The solution to the above mentioned drawbacks in the existing system is by collecting the tax automatically. Here by collecting tax automatically through wireless technology (RFID) and also through Image Processing. Every vehicle will be provided by an RF TX tag containing a unique ID. This tag will continuously emit RF signals. When the vehicle will reach at the toll booth the RF receiver will detect these RF signals. The signals are amplified and are passed to microcontroller. This microcontroller will display the id on LCD. Now, with the help of PC interface unit the data collected is passed to PC through serial port.

Software developed will show all the details about the vehicle on the screen. Details like date, time and id will be stored in the access database. Based on these details a report will be prepared. At the end of the month the system will print the detailed bill and the total amount of the toll tax for the month will also be printed. This bill will be sent to the user for payment.

By this less time is consumed as the process is quick and automatic and hence no extra time is required for paying the toll and collecting the money .Since the monthly bill will be printed and will be sent to user , paper will not be wasted .There is no chance of queuing because of the less time consumption.

Auto-Theft problem is solved by Image Processing in which the camera clicks the photo of the number plate scans with the help of O.C.R its individual character and it then feds to the system, by which the owner of the vehicle can be determined and authentication will be checked and hence security is achieved.

CHAPTER 4: IMPLEMENTATION

4.1 Work Flow Chart:

The following will be development steps so as to achieve the working Prototype Model of the above system.

- Defining the Problem.
- Understanding the Need & Usability in industry and society (Market Analysis).
- Developing Block Diagram.
- Designing Circuits of individual blocks.
- Testing circuits in LAB & Finalizing.
- Developing PCB on PC.
- Getting the PCB printed.
- Soldering the components.
- Performing various Basic Experiments to test the PCBs.
- Mounting all the PCBs consisting of soldered components.
- Developing Flowchart for the entire process.
- Writing actual Software Program.
- Compilation & Burning.
- Testing and Debugging.
- Developing Flowchart for PC Side Software.
- Developing Data Flow Diagram.
- Writing actual code.
- Finally Running the system and.
- Documentation.

4.2 HARDWARE CIRCUIT DIAGRAM:

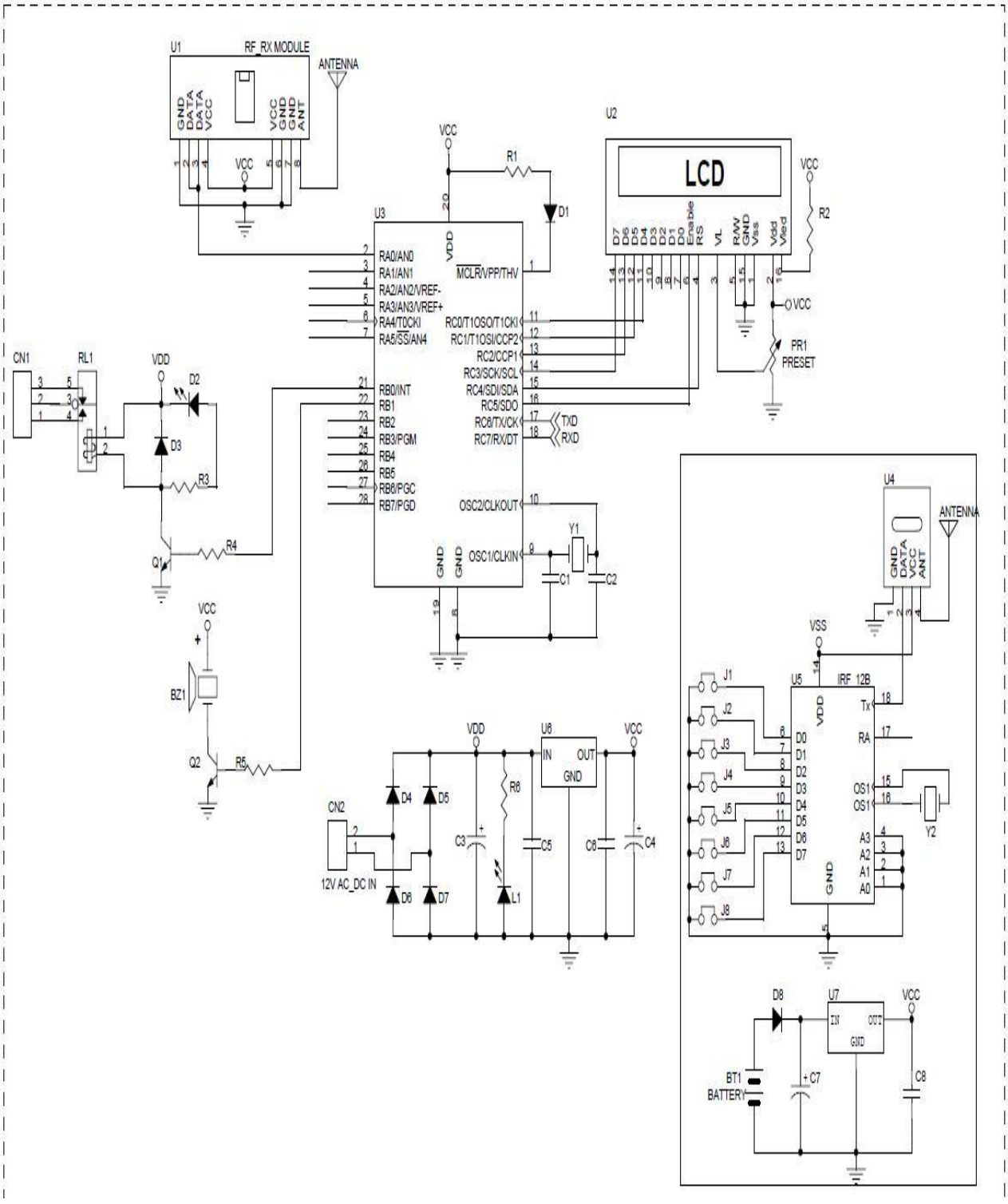

Figure 4.1 Circuit Diagram of the system

4.3 Hardware Working:

The block diagram is shown above in which we have a RF- Transmitter and a receiver section micro controller (80s52) ,a 2 x LCD Display, IR Sensor ,Camera, USB TTL,PC, a motor Driver circuit connected to a flap which is acting as a gate , and together driven by a 230V power supply.

The moment vehicle enters into the vicinity of the toll booth, the RF- TX section consisting of a encoder and a Transmitter driven by a battery which will be placed in the vehicle will generate an Identification Code (ID) which will be transmitted and will be received at the receiving end of our system installed at the toll booth through RF-Rx consisting of a decoder and a receiver.

Each vehicle will be generating its unique generation code which will be fed to the system. The code is then fed to the microcontroller circuit which is connected to a USB TTL circuit which is acting as an interface to the PC and the system.

Here the controller circuit is also connected to a LCD Display and a motor driver circuit. The Display circuit will be showing messages like STOP or Proceed on its screen for the vehicle driver. Here at the receiving end an IIR sensor is used which detects the vehicle when in the vicinity of the toll booth. A 230 V power supply is used as shown in the block diagram for driving the circuit.

Once the code is transferred to the PC through interface, the Code is stored and along with it the type of vehicle, its toll amount and the balance of the owner will be calculated by using C#.net. The database will be preserved within their system.

As soon as the following process is completed the Motor driver circuit connected to the gate through a motor will be opened, and the vehicle can easily pass ahead, But if the balance amount is zero for the user then an acknowledgement will be sent which will activate the buzzer connected and the siren will start blowing and the motor driver circuit will not be driven due to which the vehicle can't proceed and it will be forced to pay the amount by putting it in the manual lane.

The above mentioned process was through wireless technology, here an additional feature is added and that is of image processing, a camera will be installed at a particular height at the toll booth from where the number plate can easily captured, after capturing the

image the photo is fed into the PC system, which scans the image through image processing and with optical character recognition each letter is scanned and stored in the database. So along with the ID, Type of vehicle, Toll amount and balance, the Plate number of the vehicle is also stored, this helps in checking the identity of the owner and hence our circuit also helps in preventing theft.

Normally in our project each vehicle has its own 4 bit ID. The vehicle also consist of Radio Frequency (R.F) transmitter. The Radio Frequency (R.F) transmitter which is placed in the vehicle continuously transmit 4 bit ID through the R.F signal. When the vehicle reach near the toll tax booth in which Radio Frequency (R.F) receiver is placed, the RF signal from RF transmitter of vehicle is detected by RF receiver at the toll tax booth. The received Radio Frequency (R.F) signal from RF transmitter is amplify and passes to Micro-controller. The Micro-controller displays the 4 bit ID no of vehicle on the Liquid Crystal Display (L.C.D). Microcontroller connected to computer (P.C) with the help of PC interface unit.

As soon as the Radio Frequency (R.F) signal which consist of 4 bit ID of vehicle detected by the R.F receiver transmitted from RF transmitter of vehicle and also arrival of vehicle sensed by the Infrared Proximity (I.R) sensor, then the tax of the customer automatically cut from his account. Then the remaining balance show in the user account.

All the important information regarding with the customers is store in computer at which is at the toll tax booth and connected with R.F receiver. If the account of user does not have sufficient balance, then tax of the user taken by manually at the toll tax booth. Then only the vehicle of the user is allowed to go for further journey.

In our Project, the programming of Micro-controller is developed with the help of Kiel software. The software for data base is developed with the help of C#.net language. The program in C#.net language is developed with the help of Microsoft Visual studio 2010 software. All the important details about vehicles such as ID no, vehicle name plate, type of vehicle, amount of tax, amount of remaining balance store in computer and show on the screen of computer at the toll tax booth. In addition, we use Image Processing in our project through which we captures the image of Number plate of vehicle. This image is provided to the computer which is at the R.F receiver for further processing purpose.

4.4. Microcontroller:

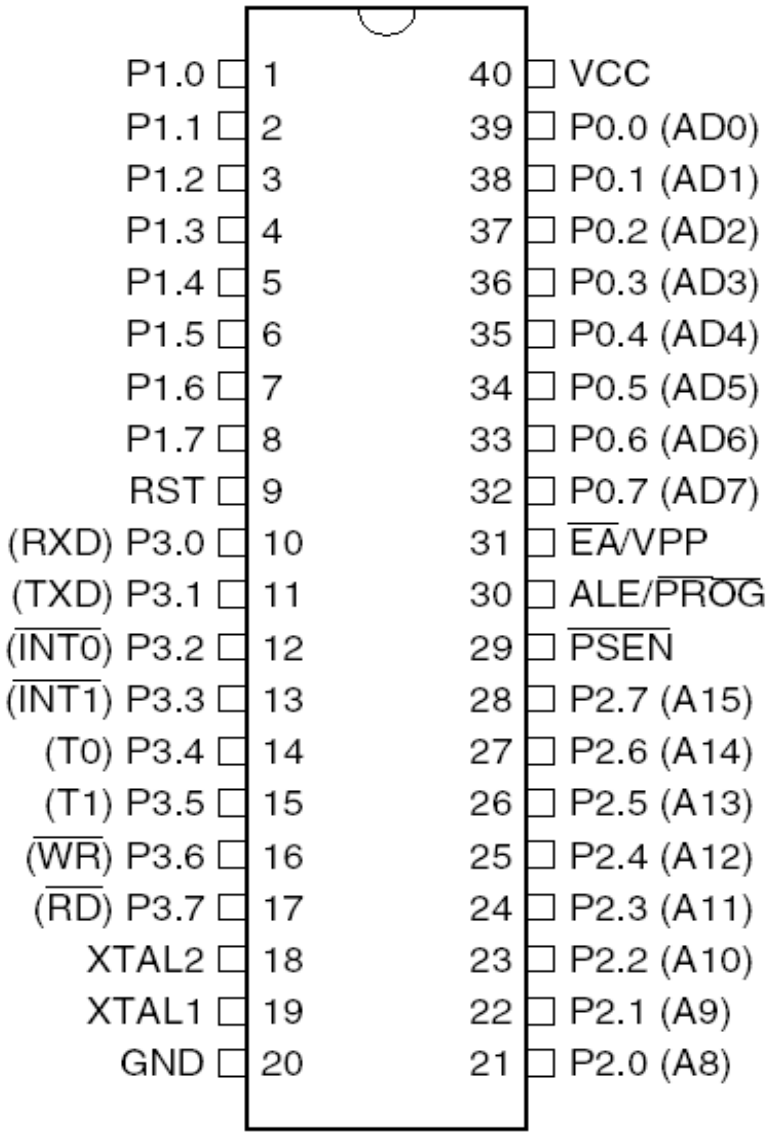

Figure 4.2 Pin Diagram of 89S52

4.4.1 Features of89S52:

• Compatible with MCS®-51 Products

• 8K Bytes of In-System Programmable (ISP) Flash Memory

– Endurance: 10,000 Write/Erase Cycles

• 4.0V to 5.5V Operating Range

• Fully Static Operation: 0 Hz to 33 MHz

• Three-level Program Memory Lock

• 256 x 8-bit Internal RAM

• 32 Programmable I/O Lines

• Three 16-bit Timer/Counters

• Eight Interrupt Sources

• Full Duplex UART Serial Channel

• Low-power Idle and Power-down Modes

• Interrupt Recovery from Power-down Mode

• Watchdog Timer

• Dual Data Pointer

Microcontroller 8051 [AT89552] is basically heart of our system. It is actually responsible for all the process being executed. It is monitor & control all the peripheral devices or components connected in the system. It is basically 40 pin IC which includes +VCC and Ground and Reset pin. In short we can say that the complete intelligence of the project resides in the software code embedded in the Microcontroller. The controller here use is of 8051 family.

The code is write in Embedded C and burned or programmed into the code memory using a programmer. This unit requires +5VDC for it proper operation.The Intel 8051 is an 8-bit microcontroller which means that most available operations are limited to 8 bits.

There are 3 basic "sizes" of the 8051: Short, Standard, and Extended. It also known 8 Bit microcontroller since it perform logical and arithmetical operation on 8 Bit data. It also consists of 4 port that are port 0 port 1, port 2 port 3.

Low-power, high-performance CMOS 8-bit microcontroller with 8KB of ISP flash memory. The device uses Atmel high-density, non-volatile memory technology and is compatible with the industry-standard 80C51 instruction set and pin out. On-chip flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. This powerful microcontroller is suitable for many embedded control applications.

4.4.2 Pin Description:

- **VCC:** Supply voltage.

- **GND:** Ground.

- **Port 0:** Port 0 is an 8-bit open-drain bi-directional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high impedance inputs. Port 0 may also be configured to be the multiplexed low order address/data bus during accesses to external program and data memory. In this mode P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming, and outputs the code bytes during program verification. External pull-ups are required during program verification.
- **Port 1:** Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 1 also receives the low-order address bytes during Flash programming and verification.
- **Port 2:** Port 2 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups.

- **Port 3:** Port3 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source Current (IIL) because of the pull-ups.

- **Port Pin Alternate Functions –**

P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	INT0 (external interrupt 0)
P3.3	INT1 (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)
P3.6	WR (external data memory write strobe)
P3.7	RD (external data memory read strobe)

Port 3 also receives some control signals for Flash programming and verification.

- **RST:** Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device.

- **ALE/PROG:** Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has Address Latch Enable output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during PSEN

- **EA/VPP:** External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH.

4.5 PCB Layout:

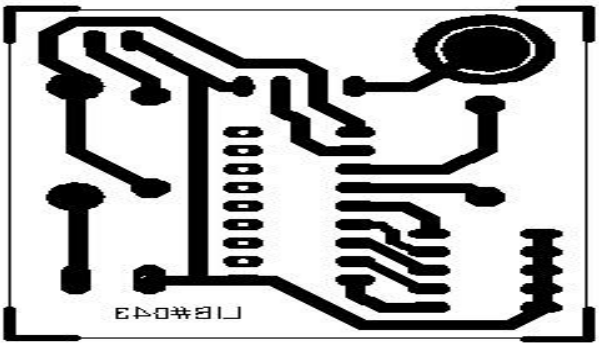

Figure: 4.3. RF Transmitter

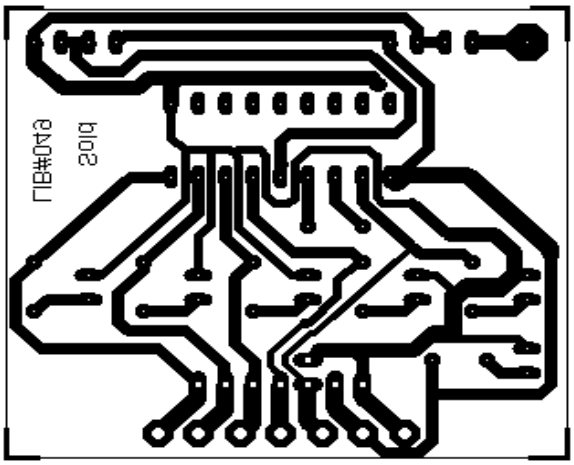

Figure: 4.4. RF Receiver

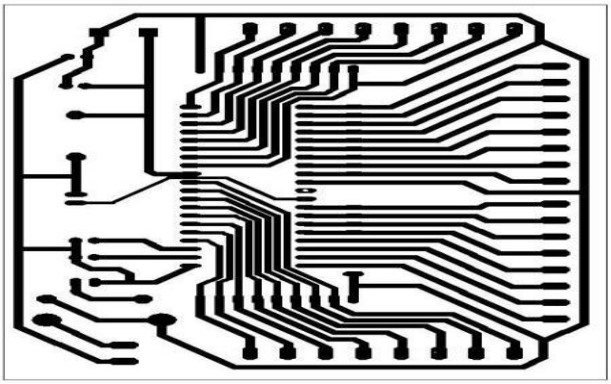

Figure: 4.5. Microcontroller

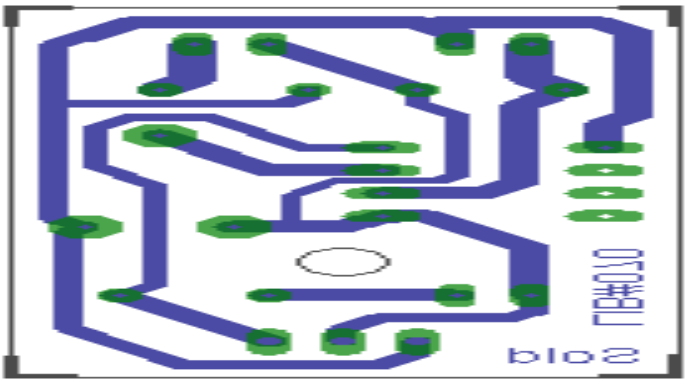

Figure: 4.6. IR Sensor

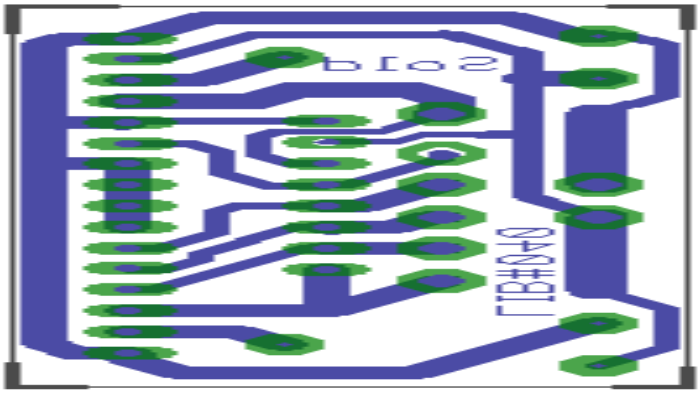

Figure: 4.7. LCD Display

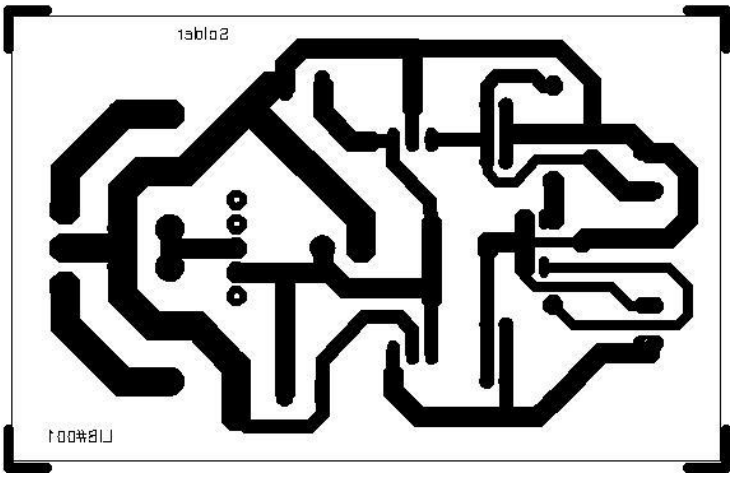

Fig. 4.8. Power Supply.

4.6 Software Working:

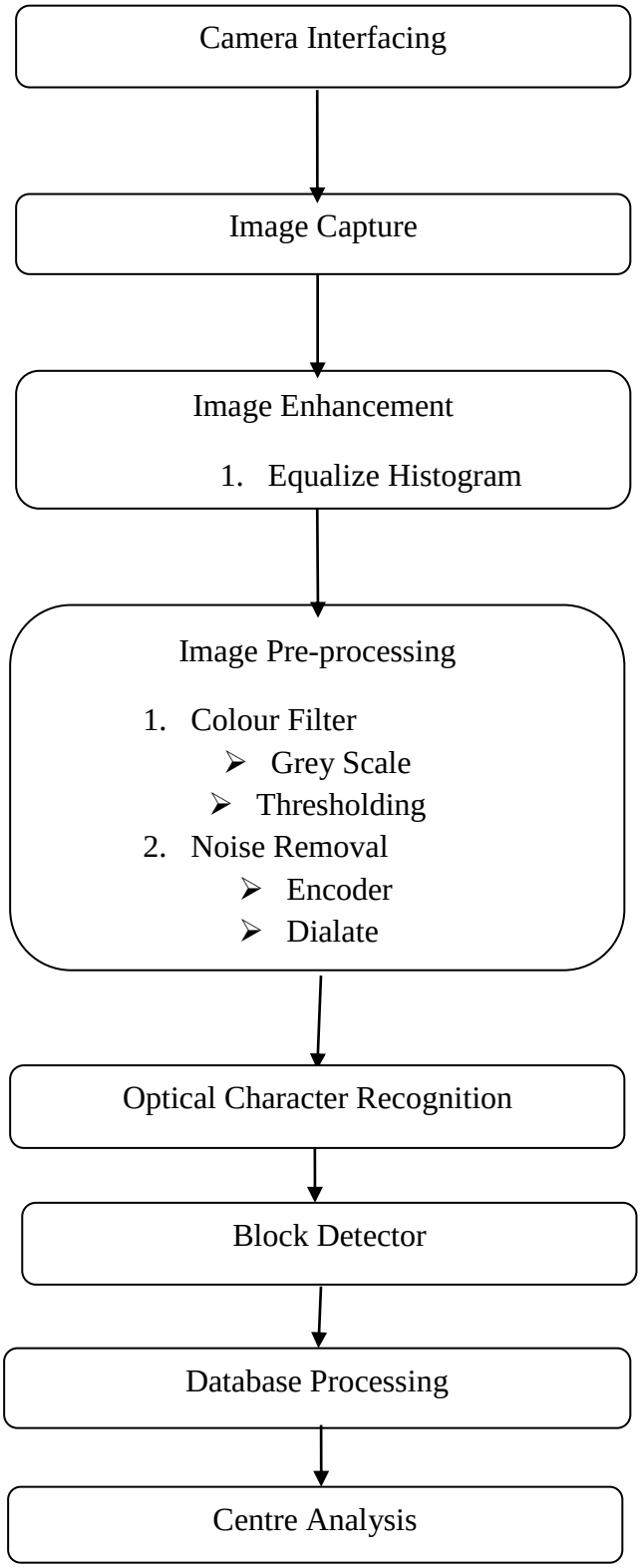

Fig. 4.9. Software Flow Chart

4.7. Optical Character Recognition: Algorithm

Optical character recognition (**OCR**) is the mechanical or electronic conversion of images of typewritten or printed text into machine-encoded text. It is widely used as a form of data entry from printed paper data records, whether passport documents, invoices, bank statements, computerized receipts, business cards, mail, printouts of static-data, or any suitable documentation. It is a common method of digitizing printed texts so that it can be electronically edited, searched, stored more compactly, displayed on-line, and used in machine processes such as machine translation, text-to-speech, key data and text mining. OCR is a field of research in pattern recognition, artificial intelligence and computer vision.

Early versions needed to be trained with images of each character, and worked on one font at a time. Advanced systems that have a high degree of recognition accuracy for most fonts are now common. Some systems are capable of reproducing formatted output that closely approximates the original page including images, columns, and other non-textual components.

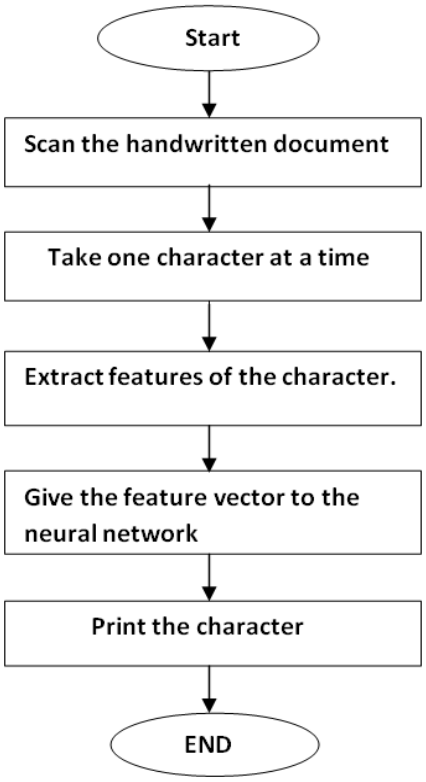

Fig. 4.10. OCR Algorithm

4.8. Code

Code for Various Register Definitions for 89C51 MC

```
#ifndef __89C51_H__

#define __89C51_H__

//Byte Registers

sfr P0      = 0x80;

sfr SP      = 0x81;

sfr DPL     = 0x82;

sfr DPH     = 0x83;

sfr PCON    = 0x87;

sfr TCON    = 0x88;

sfr TMOD    = 0x89;

sfr TL0     = 0x8A;

sfr TL1     = 0x8B;

sfr TH0     = 0x8C;

sfr TH1     = 0x8D;

sfr P1      = 0x90;

sfr SCON    = 0x98;

sfr SBUF    = 0x99;

sfr P2      = 0xA0;

sfr IE      = 0xA8;

sfr P3      = 0xB0;
```

```
sfr IP      = 0xB8;

sfr PSW     = 0xD0;

sfr ACC     = 0xE0;

sfr B       = 0xF0;


//P0 Bit Registers

sbit P0_0 = 0x80;

sbit P0_1 = 0x81;

sbit P0_2 = 0x82;

sbit P0_3 = 0x83;

sbit P0_4 = 0x84;

sbit P0_5 = 0x85;

sbit P0_6 = 0x86;

sbit P0_7 = 0x87;


//P1 Bit Registers

sbit P1_0 = 0x90;

sbit P1_1 = 0x91;

sbit P1_2 = 0x92;

sbit P1_3 = 0x93;

sbit P1_4 = 0x94;

sbit P1_5 = 0x95;

sbit P1_6 = 0x96;
```

```
sbit P1_7 = 0x97;

//P2 Bit Registers

sbit P2_0 = 0xA0;

sbit P2_1 = 0xA1;

sbit P2_2 = 0xA2;

sbit P2_3 = 0xA3;

sbit P2_4 = 0xA4;

sbit P2_5 = 0xA5;

sbit P2_6 = 0xA6;

sbit P2_7 = 0xA7;


//P3 Bit Registers

sbit P3_0 = 0xB0;

sbit P3_1 = 0xB1;

sbit P3_2 = 0xB2;

sbit P3_3 = 0xB3;

sbit P3_4 = 0xB4;

sbit P3_5 = 0xB5;

sbit P3_6 = 0xB6;

sbit P3_7 = 0xB7;

//ACC Bit Registers

sbit ACC_0      = 0xE0;

sbit ACC_1  = 0xE1;
```

```
sbit ACC_2  = 0xE2;

sbit ACC_3  = 0xE3;

sbit ACC_4  = 0xE4;

sbit ACC_5  = 0xE5;

sbit ACC_6  = 0xE6;

sbit ACC_7  = 0xE7;


//B Bit Registers

sbit B_0 = 0xF0;

sbit B_1 = 0xF1;

sbit B_2 = 0xF2;

sbit B_3 = 0xF3;

sbit B_4 = 0xF4;

sbit B_5 = 0xF5;

sbit B_6 = 0xF6;

sbit B_7 = 0xF7;


//TCON Bit Registers

sbit IT0  = 0x88;

sbit IE0  = 0x89;

sbit IT1  = 0x8A;

sbit IE1  = 0x8B;

sbit TR0  = 0x8C;
```

```
sbit TF0  = 0x8D;

sbit TR1  = 0x8E;

sbit TF1  = 0x8F;

//SCON Bit Registers

sbit RI   = 0x98;

sbit TI   = 0x99;

sbit RB8  = 0x9A;

sbit TB8  = 0x9B;

sbit REN  = 0x9C;

sbit SM2  = 0x9D;

sbit SM1  = 0x9E;

sbit SM0  = 0x9F;


  //IE Bit Registers

sbit EX0  = 0xA8;

sbit ET0  = 0xA9;

sbit EX1  = 0xAA;

sbit ET1  = 0xAB;

sbit ES   = 0xAC;

sbit ET2  = 0xAD;

sbit EA   = 0xAF;

  #endif
```

Code for Various Functions for Delayed Tasks

```
//*****************************************************************************

#ifndef __DELAY_H__

#define __DELAY_H__


#pragma SAVE

#pragma REGPARMS

extern void DelayL(unsigned long Delay);//Delay for long time

extern void DelayI(unsigned int Delay);//Delay for small time

extern void DelayU(unsigned int Delay);//Delay for specific microseconds

extern void DelayM(unsigned int Delay);//Delay for specific milliseconds

#pragma RESTORE


#endif
```

Code for Displaying on LCD

```
**************************************************************

#ifndef __LCD4NW_H__

#define __LCD4NW_H__


#define   RS            P1_2                //registor select

#define E               P1_3                //enable

#define DATA   P1                         //data lines


#pragma SAVE

#pragma REGPARMS


extern void SetLCD(void);               //initiates LCD

extern void LCD(unsigned char L);//0-clear display, 1-Line 1, 2-Line 2

extern char putchar(char);              //prints single character on LCD

#pragma RESTORE

#endif
```

Main Code

```
//Headers-------------------------------------------------------------------------------------------

#include <stdio.h>//standard input output

#include "89C51.h"  //89c51 definations

#include "Delay.h"

#include "Serial.h"

#include "LCD4NW.h"

//Definitions---------------------------------------------------------------------------------------

#define   MR                    P0_0

#define   MB                    P0_1

#define   IR                    P3_2

#define Buzzer   P3_7


#define rfVT              P2_4

#define rfPort     P2&0x0f

//Functions-----------------------------------------------------------------------------------------

void Beep(unsigned char No,unsigned int Delay);

unsigned char ReadRF(unsigned long SDelay);

//Variables-----------------------------------------------

unsigned char CMD;

unsigned char RFID;

//-------------------------------------------------------------------------------------------
```

```
void main(void)
{
  //Peripheral Initialization----------------------------------------------------------------------
  MR=MB=0;
  Beep(3,200);
  SetSerial(9600,11059200,12);
  SetLCD();

  //Greeting MSG-----------------------------------------------------------------------------
  LCD(1);printf("   Welcome to   ");
  LCD(2);printf("   K.C.C.O.E. Toll Booth  ");
  DelayM(3000);
  LCD(1);printf(" RFID & Vision  ");
  LCD(2);printf("Based Toll Tax. ");
  DelayM(3000);
  LCD(1);printf("Project Done by.");
  LCD(2);printf("*****************");
  DelayM(3000);
  LCD(1);printf("Gaurav Shelar   ");
  LCD(2);printf("Mohit Tandon    ");
  DelayM(3000);
  LCD(1);printf("Amol Tannu      ");
  LCD(2);printf("Pradeep Singh   ");
```

```
DelayM(3000);
LCD(1);printf("Under Guidance..");
LCD(2);printf("Prof. Rajiv Iyer");
DelayM(3000);
//Greeting MSG-----------------------------------------------------------------------


LCD(1);printf("System Started..");
LCD(2);printf("*****************");
DelayM(2000);


while(1)
{       LCD(1);printf("Wating for      ");
LCD(2);printf("Vehicle.....");
          while(IR==0);
          Beep(1,100);
          while(1)
          {                   RFID=ReadRF(30000);
                              if((RFID==0)||(RFID==15))continue;


                              LCD(0);
                              LCD(1);printf("RFID:%bu",RFID);
                              Beep(1,200);
                              break;
```

```
}

//send trigger to PC

Send(RFID);


LCD(1);printf("      STOP      ");

LCD(2);printf("  Pay the Tax    ");


while((CMD=Read())!='S');    //wait for PC Response


Beep(1,100);

MR=1;MB=0; //rotate motor

DelayM(400);//wait for some time

MR=0;MB=0;//stop motor


LCD(1);printf("Thank You !!!    ");

LCD(2);printf("You May Go.....");


while(IR==1);

DelayM(2000);//wait for some time

Beep(1,100);

MR=0;MB=1; //rotate motor

DelayM(400);//wait for some time

MR=0;MB=0;//stop motor
```

```
}//end while
}//main
//#############################################################################
void Beep(unsigned char No,unsigned int Delay)
{
  unsigned char tNo;
  for(tNo=1;tNo<=No;tNo++)
  {
        Buzzer=0;
        DelayM(Delay);
        Buzzer=1;
        DelayM(Delay);
  }
}
unsigned char ReadRF(unsigned long SDelay)
{
  unsigned long tSDelay;
  unsigned char KeyCode=0;
  for(tSDelay=0;tSDelay<=SDelay;tSDelay++)
  {     if(rfVT)
        {     KeyCode=rfPort;
              break;     }
  }    return(KeyCode);}
```

Code for Controlling Serial Communication

```
**************************************************************************
#ifndef __SERIAL_H__
#define __SERIAL_H__


#pragma SAVE
#pragma REGPARMS
extern void SetSerial(unsigned long BaudRate,unsigned long XTAL,unsigned char ClkDiv);//intitialize serial port,baudrate,xtal frequency,clock divider
extern void SetSerial115200(void);//set fixed baudrate for phlips
extern void Send(unsigned char c);//transmits one character
extern void SendString(unsigned char *String,unsigned char Len);//transmit complete string
extern unsigned char Read(void);//reads one character & waits till it comes
extern unsigned char ReadD(unsigned int Delay);//reads one character & waits for specified time only
#pragma RESTORE


#endif
```

CHAPTER 5: RESULTS

Result 1: As soon as the system gets started by applying power supply, the LCD displays the following message as shown below, which indicates that the system is ready and is waiting for the vehicle to cut the IR sensor at the gate end for further processing.

Fig.5.1. Initial process

Result 2: Here as shown below, toll tax has been collected for the no. plate MH-01 AB 1234 using RFID, as soon as the vehicle with the mentioned no. plate cuts the IR sensor, the process of deduction gets executed and the gate gets open to pass the vehicle. This picture shows how image processing is been used in the system for detection of the No. plate.

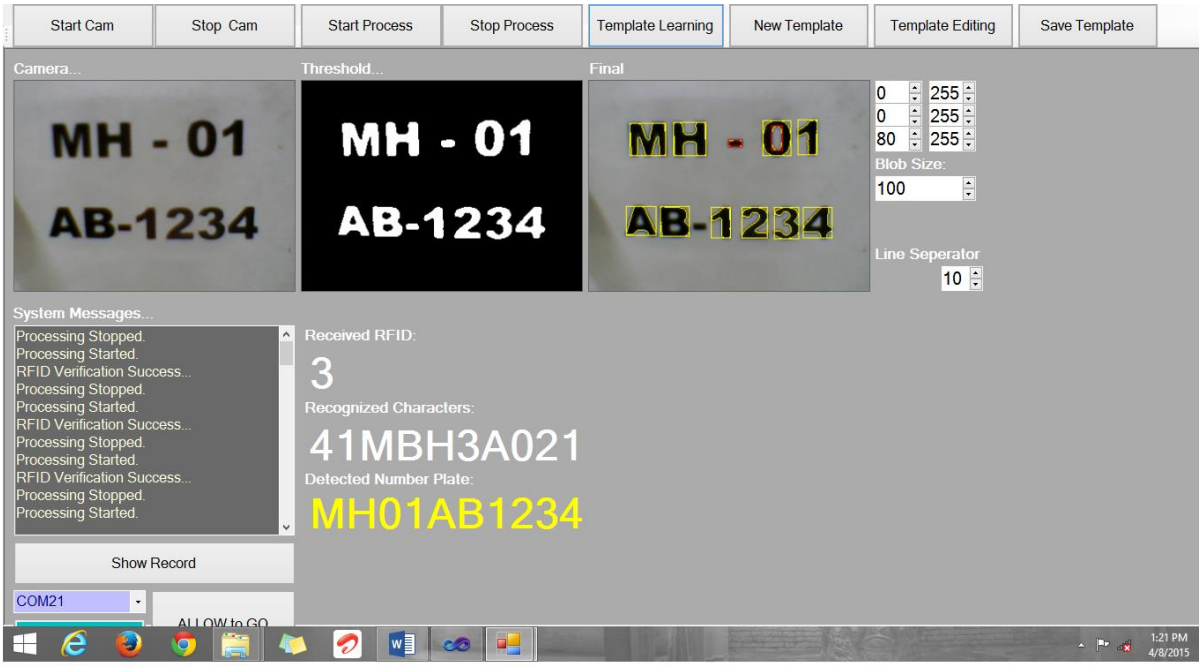

Fig 5.2. Toll been collected by the system

Result 3: The picture below displays the record observed in the system, for the no. plate mentioned above. The system's database not only stores the RFID no. and Balance but also the user name, The Tax, Address, Phone no. , Email Id and Description about the vehicle

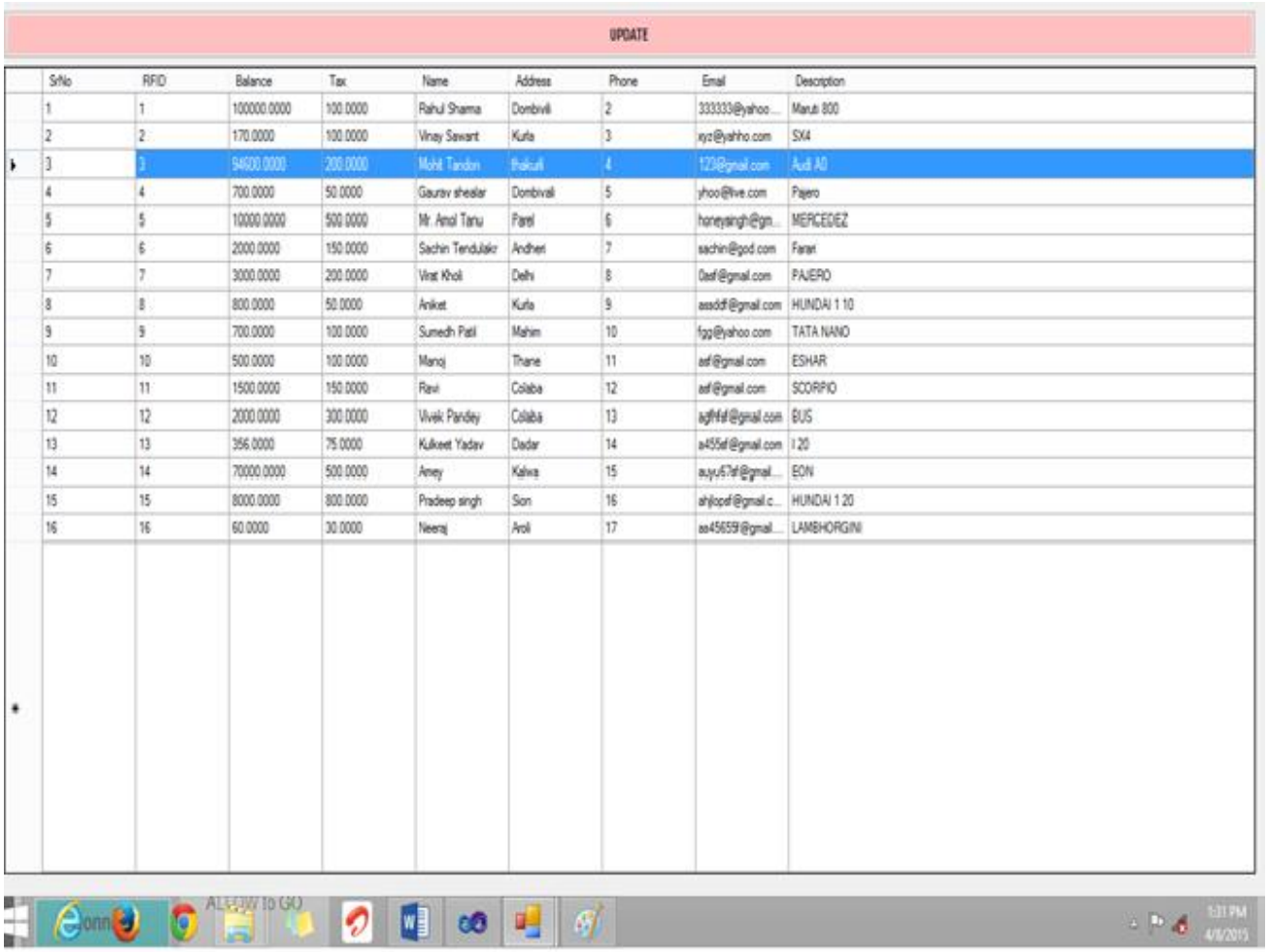

Fig 5.3.Database of the system

Result 4: In this case , we have observed "Low Balance", which indicates that the balance in the database for this particular vehicle owner is less and hence he cannot move forward and thus will have to pay the tax manually**.**

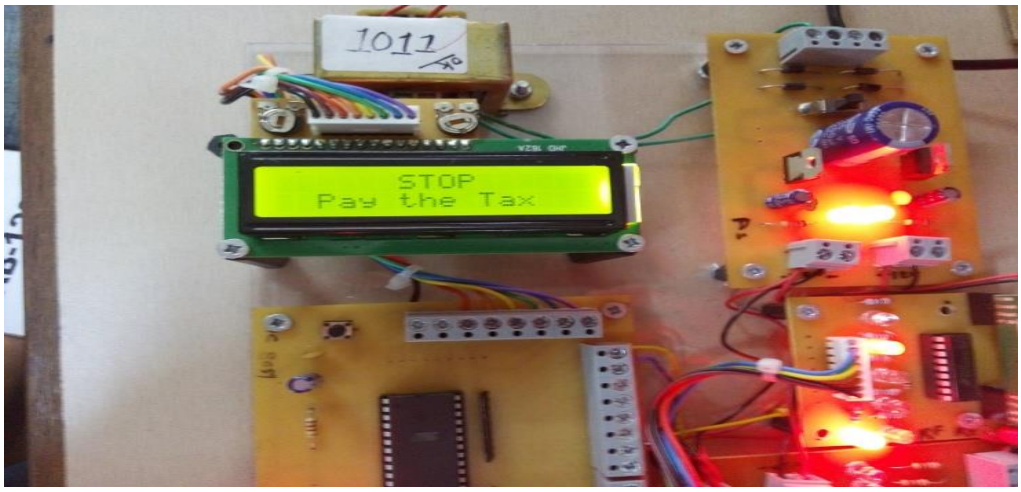

Fig 5.4. Indication for paying the toll tax of the vehicle

The above fig. shown in the LCD is displayed to all the vehicle arriving at the toll booth, as an indication that the toll will be collected/deducted from your account automatically.

Fig5.5. Result displaying for Low Balance

Result 5: Finally the process gets completed provided there is sufficient balance in user's account, and then the LCD displays an allowance for the vehicle to pass the gate, which gets opened automatically.

Fig 5.6.Allowing the vehicle to proceed after collection

Result 6: Thus if the process is completed successfully, the system gets updated by deducting the tax from that specific user.

UPDATE

SrNo	RFID	Balance	Tax	Name	Address	Phone	Email	Description
1	1	100000.0000	100.0000	Rahul Sharma	Dombivli	2	333333@yahoo....	Maruti 800
2	2	170.0000	100.0000	Vinay Sawant	Kurla	3	xyz@yahho.com	SX4
3	3	94400.0000	200.0000	Mohit Tandon	thakurli	4	123@gmail.com	Audi A0
4	4	700.0000	50.0000	Gaurav shealar	Dombivali	5	yhoo@live.com	Pajero
5	5	10000.0000	500.0000	Mr. Amol Tanu	Parel	6	honeysingh@gm...	MERCEDEZ
6	6	2000.0000	150.0000	Sachin Tendulakr	Andheri	7	sachin@god.com	Farari
7	7	3000.0000	200.0000	Virat Kholi	Delhi	8	0asf@gmail.com	PAJERO
8	8	800.0000	50.0000	Aniket	Kurla	9	assddf@gmail.com	HUNDAI 1 10
9	9	700.0000	100.0000	Sumedh Patil	Mahim	10	fgg@yahoo.com	TATA NANO
10	10	500.0000	100.0000	Manoj	Thane	11	asf@gmail.com	ESHAR
11	11	1500.0000	150.0000	Ravi	Colaba	12	asf@gmail.com	SCORPIO
12	12	2000.0000	300.0000	Vivek Pandey	Colaba	13	agfhfsf@gmail.com	BUS
13	13	356.0000	75.0000	Kulkeet Yadav	Dadar	14	a455ef@gmail.com	I 20
14	14	70000.0000	500.0000	Amey	Kalwa	15	auyu67sf@gmail....	EON
15	15	8000.0000	800.0000	Pradeep singh	Sion	16	ahjlopsf@gmail.c...	HUNDAI 1 20
16	16	60.0000	30.0000	Neeraj	Arol	17	as45655f@gmail....	LAMBHORGINI

Fig.5.7.Final Updated record in the database.

CHAPTER 6: ADVANTAGES, LIMITATIONS & FUTURE SCOPE

6.1 Advantages:

- **Automatic collection of toll tax**: By collecting the tax automatically problems with pursuing toll evaders are solved. Till the system sends an acknowledgement to the motor driver circuit the gate will not open, and hence evading will not be possible.

- **Free flow of traffic:** This is very important during peak hours when the vehicles are more, the moment toll booth is reached the amount is collected wirelessly, there is hardly any time required for the process and hence free flow is achieved.

- **Time saving:** There is heavy time saved ,as the process is done wirelessly and by image processing by the system .Within a minute the work can be achieved , provided the authentication is achieved and there is sufficient balance present in the account.

- **Record maintenance:** As every vehicles database will be created and fed in the system each vehicle's record will be maintained and hence it can help traffic police during any theft, and also by maintaining the records a system generated bill will be sent to the owner at the end of every month, which prevents wastage of paper.

6.2 Limitations:

- **The proposed system will take care of only single toll depot:** The capacity to handle more than one booth is not possible and hence the systems need to be installed at every toll booth.

- **It is not the centralised system**: As there is each system for each toll booth, they are not controlled by any central system unlike PC networks controlled by a central server due to which at every toll booth the system needs to be managed.

- **Multiple RF TX cannot work together**: At instance only one RF -Tx can send the data, once that is completed the other vehicle ID generated will be processed .If many vehicles are generating ID simultaneously then the system may get loaded.

- **This system will increase the stationery cost:** A person is required to print and send the bill to the user: Comparatively the cost is less as compared to the previous methods, but sending bill to the person will require stationary at end of every month, which increases the cost.

- **Low Range IIR SENSOR:** This work describes the practical implementation of Automatic toll Collecting System using Wires and IR. Since infrared has very low range, this system work fine only for small distances.

6.3 Future Scopes:

Various new techniques have been emerged in this field to make his system more reliable and efficient.

- For greater distances microwave, RF can be used.
- Using RF the same system with little modifications can be used to locate a person in a building i.e. this system can be used to enhance the security in the building.
- Further Microcontroller Based Automatic Toll Collection System 799the system may use any existing local GSM/CDMA network for collection of Toll payment. This can be done using SMS or any other VAS (Value Added Services) related features.
- The same idea can also be used to improve car parking, traffic control and security systems. Centralised system for toll tax collection among all the toll tax depots. Monthly bill can be automatic send by Email or the bill amount can be informed by SMS to the user.

6.4. Applications:

The toll collection systems rely on four major components, namely Automated Vehicle Identification, Automated Vehicle Classification, Transaction Processing, and Violation Enforcement. This section discusses each of these further.

- **Automated Vehicle Identification:** Automated Vehicle Identification (AVI) is the process of determining the identity of a vehicle subject to tolls. The AVI system relies on radio-frequency identification (RFID), where an antenna at the toll gate communicates with a transponder on the vehicle. RFID tags have proved to have excellent accuracy, and can be read at highway speeds.

- **Automated Vehicle Classification:** Automated Vehicle Classification (AVC) is closely related to Automated Vehicle Identification (AVI). Most toll facilities charge different rates for different types of vehicles, making it necessary to distinguish the vehicles passing through the toll facility. The method is to store the vehicle class in the customer record, and use the AVI data to look up the vehicle class.

- **Transaction Processing:** Transaction Processing deals with maintaining customer accounts, posting toll transactions and customer payments to the accounts, and handling customer inquiries. The Transaction Processing function resembles banking, and toll agencies can contract out transaction processing to a bank. Customer accounts may be postpaid, where toll transactions are periodically billed to the customer, or prepaid, where the customer funds a balance in the account which is then depleted as toll transactions occur. The prepaid system is more common, as the small amounts of most tolls makes pursuit of uncollected debts uneconomic.

- **Violation enforcement: A** Violation Enforcement System (VES) is useful in reducing unpaid tolls, as an unmanned toll gate otherwise represents a tempting target for toll evasion. Several methods can be used to deter toll violators. A physical barrier, such as a gate arm, ensures that all vehicles passing through the toll booth have paid a toll. Violators are identified immediately, as the barrier will not permit the violator to proceed.

CHAPTER 7: CONCLUSION

By the realization of the above system we can make the Toll Tax collection system more efficient and can reduce the traffic logging on the highways. This system will save a lot of precious time of the driver, passengers as well as of the tax collection authorities. It has characteristics of low cost, high security, far communication distance and high efficiency, etc.

The system not only can improve technology level of charge, but also improve passage ability of express ways. Electronic toll collection system is an effective measure to reduce management costs and fees, at the same time, greatly reduce noise and pollutant emission of toll station.

The system reduces the manual labor and delays that often occurs on roads. This system of collecting toll is eco-friendly and also results in increase toll lane capacity. Also an anti-theft solution system module which prevents passing of any defaulter vehicle is implemented, thus assuring security on the road ways.

REFERENCES

- **Embedded Books & Links**

[1] James R. Groff, Paul N. Weinberg, *SQL: The Complete Reference*, First Edition, Osborne/McGraw-Hill, ISBN 0-07-211845-8.

[2] RFID based toll collection system, 2011 IEEE third international Conference

[3] Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins "Digital image processing using MATLAB", Prentice Hall, 2003.

[4] Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, 10th Edition, Prentice-Hall, Page: 342, 417, 455.

[5]http://www.circuitlake.com/interfacing-8-lcd-displays-to-microcontroller-with-only-two-wires.html

- **IEEE PAPERS**

[1].Automatic Vehicle Registration System for Tollbooths: {978-1-4577-0787-2/11/$26.00 ©2011 IEEE}

[2] AUTOMATIC TOLL TAX COLLECTION USING RFID: IJRIM Volume 3, Issue 4 (April 2013) (ISSN 2231-4334): International Journal of Research in IT & Management 13

[3]AUTOMATIC TOLL COLLECTION SYSTEM USING RFID International Journal of Electrical and Electronics Research ISSN 2348-6988 (online) Vol. 2, Issue 2, pp: (67-72), Month: April - June 2014.

[4] Automatic Toll Gate System Using Advanced RFID and GSM Technology, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 11, November 2014

[5] Electronic toll collection technologies: A state of art review, Volume 4, Issue 7, July 2014

ISSN: 2277 128X

- **Software Books &Links**

[1] Gary Cornell & Jonathan Marrison, Programming VB.Net: A Guide for experienced programmers, Second Edition 2002, ASPToday Publication, ISBN (pbk): 1-893115-99-2, 424 Pages.

[2]Dave Grundgeiger, *Programming Visual Basic.Net*, First Edition 2002, O'Reilly Publication, ISBN: 0-596-00093-6, 464 Pages.

Vision based Automatic Toll Tax Collection System using Image Processing and Wireless Technology

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***ABSTRACT*-A Toll Tax is a tax that has been often used historically on roads and bridges to pay for state bridge and road projects. What eventually has been observed is heavy traffic lead to congested roads leading to heavy time loss. Thus we have proposed asystem which not only takes care of the long queues but also ensures security of vehicles and hence achieving prevention from theft. This paper focuses on an automatic toll collection (ATC) system using radio frequency identification (RFID) technology. The proposed RFID system uses tags that are mounted on the vehicles, through which information embedded on the tags are read by RFID readers. The proposed system eliminates the need for vehicles and toll authorities to manually perform ticket payments and toll fee collections, respectively. With the advancement in computation, the era of automatic systems is rapidly taking over. Image processing is an essential tool being widely used in effective solutions concerning such systems. Thus we have also proposed an effective method to extract the digits from the license plate of a vehicle which can be used to fully automatize the access system at the barrier gate. The algorithm accounts for various anomalies in the system which may include movements at the gates and so on .Thus the final project will be comprising of a combined process of RFID and Image Processing.**

Keywords –Congested roads, Automatic toll collection (ATC), RFID tags,Image Processing.

I. INTRODUCTION

Among the few things which characterize our major populated cities in our nation is the amazing local transport system, which mainly compromises of the Railways and equally important land transportation systems which regulates the proper functioning of the local trains almost round the clock. Taking into consideration the large amount of traffic commuting everyday on roads the land transportation system is responsible for safe and sound transportation of the people of this perennially busy city which never sleeps. We have
proposed a system which solves the issue of long queues and eventually achieving traffic control which are observed at toll region .

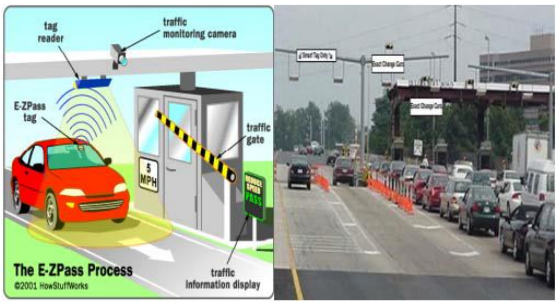

Fig 1.Toll Tax System.

The highly instrument-based system is intended to perform functions like detecting vehicles and then data-formatting and transfer to the use. In short, the transport and traffic sectors would be the major gainers of the system. Whenever a vehicle passes through the toll gate, crucial data such as vehicle number, the toll fee payments, and so on are all recorded and hence are retrievable by the personnel concerned. These series of actions ensure the building up of a database and second the collection of toll fee thus eliminating the chances of misuse or loss of revenue due to non deposit/collection of toll tax. Each vehicle will be provided by an RFID tag containing a unique ID. This tag will continuously emit RF signals. When the vehicle will

reach at the toll booth the RF receiver will detect these RF signals. The signals are amplified and are passed to microcontroller. This microcontroller will display the ID on LCD. Here we carry on two processes simultaneously one is using RFID and the other is image processing. We generate a database containing the vehicle's owner information such as Name, Address, and Type of vehicle, Toll amount and Balance. Along with it there is a column for ID generated by the tags generated by Tx and Rx, thus the RFID process is carried on by matching the ID received by the vehicle near toll with the IDs stored in the database. Also we are using a camera which captures the number plate image of the vehicle and then it send it for further processing using Visual Studio 2000 using C# .net and eventually the image is stored in the system for matching process, when the image matches with the number of the plate stored in the database, toll is detected ,this also provides an additional feature of preventing auto theft.

II. SYSTEM MODEL

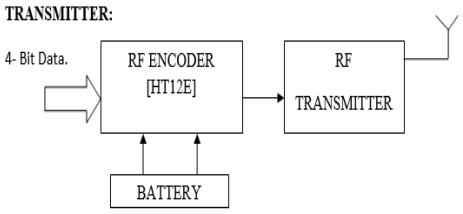

Figure 2. Block Diagram of Transmitter

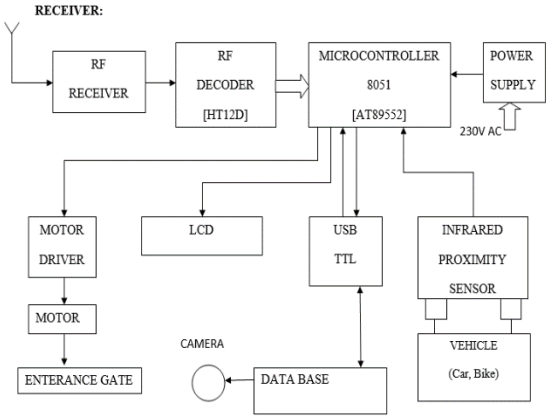

Figure 3. Block Diagram of Receiver

The block diagram is shown above in which we have a RF-Transmitter and a receiver section micro controller (80s52) ,a 2 x LCD Display, IR Sensor ,Camera, USB TTL,PC, a motor Driver circuit connected to a flap which is acting as a gate , and together driven by a 230V power supply. The moment vehicle enters into the vicinity of the toll booth, the RF- Tx section consisting of a encoder and a Transmitter driven by a battery which will be placed in the vehicle will generate an Identification Code (ID) which will be transmitted and will be received at the receiving end of our system installed at the toll booth through RF-Rx consisting of a decoder and a receiver. Each vehicle will be generating its unique generation code which will be fed to the system. The code is then fed to the microcontroller circuit which is connected to a USB TTL circuit which is acting as an interface to the PC and the system. Here the controller circuit is also connected to a LCD Display and a motor driver circuit. The Display circuit will be showing messages like STOP or Proceed on its screen for the vehicle driver. Here at the receiving end an IIR sensor is used which detects the vehicle when in the vicinity of the toll booth. A 230 V power supply is used as shown in the block diagram for driving the circuit. Once the code is transferred to the PC through interface, the Code is stored and along with it the type of vehicle, its toll amount and the balance of the owner will be calculated by using C#.net. The database will be preserved within their system. As soon as the following process is completed the Motor driver circuit connected to the gate through a motor will be opened , and the vehicle can easily pass ahead, but if the balance amount is zero for the user then an acknowledgement will be sent which will activate the buzzer connected and the siren will start blowing and the motor driver circuit will not be driven due to which the vehicle can't proceed and it will be forced to pay the amount by putting it in the manual lane .The above mentioned process was through wireless technology, here an additional feature is added and that is of image processing , a camera will be installed at a particular height at the toll booth from where the number plate can easily captured , after capturing the image the photo is fed into the PC system , which scans the image through image processing and with optical character recognition each letter is scanned and stored in the database. So along with the ID, Name, Address Type of vehicle, Toll amount and balance, the Plate number of the vehicle is also stored, this helps in checking the identity of the owner and hence our circuit also helps in preventing theft.

A. RF ENCODER HT12E:

This unit is used to encode the 4-bit data before transmitting it in the communication channel. Basically it generates a serial bit stream of the parallel input data bits. It then sends data stream to RF transmitter unit. This unit requires +5V to 12V DC for it proper operation.

B. RF TRANSMITTER:

This unit performs very significant roll i.e. it is responsible for the modulation (ASK, CF-434MHz) of the message or data to be transferred. Once the data is modulated then is transmitted or launched in Air by the help of the antenna. The baud rate is generally 1200bps and the range will be up to 100 ft.This unit requires +5V to 12V DC for it proper operation.

C. THE RF RECEIVER:

This unit performs very significant roll i.e. it is responsible for the demodulation of the message or data after reception from air. This section is internally constructed with Amplifier unit, Filter unit, Peak Detector, Sample and Hold circuit and Level Shifter.

D. RF DECODER HT12D:

This unit is used to decode the 4-bit after receiving it from the RF Receiver unit. Basically it generates a parallel data

from the serial incoming bit stream. This unit requires +5 to 12VDC for it proper operation.

E. POWER SUPPLY:

This unit will supply the various voltage requirements of each unit. This will be consists of transformer, rectifier, filter and regulator. The rectifier used here will be Bridge Rectifier. It will convert 230VAC into desired 5V/12V DC.

F. MICROCONTROLLER:

This unit is the heart of the complete system. It is actually responsible for all the process being executed. It will monitor & control all the peripheral devices or components connected in the system. In short we can say that the complete intelligence of the project resides in the software code embedded in the Microcontroller. The controller here user will be of 8051 family. The code will be written in Embedded C and will be burned or programmed into the code memory using a programmer. This unit requires +5VDC for it proper operation.

G. LCD 16x2:

It is called Liquid Crystal Display. We are going to use 16x2 character LCD. This will be connected to microcontroller. The job of LCD will be to display all the system generated messages coming from the controller. LCD will provide interactive user interface. This unit requires +5VDC for it proper operation.

H. USB TTL:

A USB adapter is a type of protocol converter which is used for converting USB data signals to and from other communications standards. Commonly, USB adaptors are used to convert USB data to standard serial port data and vice versa.

I. IIR SENSOR:

It is an infrared sensor used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion.

J. MOTOR DRIVER CIRCUIT:

A motor controller is a device or group of devices that serves to govern in some predetermined manner the performance of an electric motor. A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults. Every electric motor has to have some sort of controller. The motor controller will have differing features and complexity depending on the task that the motor will be performing.

III. EXPERIMENTAL OBSERVATIONS & RESULTS

Fig.4Step1:Camera Interfacing

The starting step in the additional process of image processing is as follows- A camera is used which captures the number plate image and then it is fed to the PC working with c#Algorithm along with SQL for database.The camera interface is shown in Fig.4 which is connected to the microcontroller through which the image is fed to the PC for futher process.

Fig.5Step 2: Image capturing

The captured image is shown above ,here it is important to ensure the camera is at a decent height and also the number plate is at a standard high from the ground level so as to get a proper image with entire digits which are easily visible .

Fig. 6 Step 3: Image Pre-processing(Gray-scale ,noise removal etc)

After the image being captured we are enhancing the image or equalising it using Histrogram.With the pre-processing the following tasks are been performed, from color filter, grey scale and thresholding.During the process, there is a possiblity of noise occurence and hence it is essinital to remove the noise disturbance and then details

encoded through encoder.A gray scale image is shown in Fig.6

Fig.7 Step 4: Blob Detection

Here, using Block detector each character of the number plate is detected through counter analysis.Here the above process can also be achieved using OCR i.e. Optical character Recognition as shown in Fig.7

Fig.8 Step 5: Segregated Characters

As soon as the blob detection process is done , we get the segregated characters as shown in Fig. 8 ,these characters in arranged manner are then send for matching process in the system where the generated image and the vehicle number (already in the database) are matched for toll detection.

TABLE I - Final Database Observation

No Plate	***ID***	***Name***	***Address***	***Type of Vehicle***	***Toll Amount***	***Balance Left***
HP 67 -7588	1048	Mr. Ram Nair	A-9, Vajra hanuman Society,Cholegaon, Thakurli(E)	Car	50	950
HR 67-1234	2993	Mr. Vijay Das	101,TULIP TOWER,Tilak road,Dombivli(W)	Car	50	2900
MH 05 -6475	1435	Mrs. Reeta Verma	Plot no. 78 ,Nair Niwas , M .G .road ,Thane (E)	Car	50	1050
PJ 04 – 7322	7433	Mr. Sanjay Gupta	D-1001, 2nd Floor, Ram Niwas Society , Near MSST School,Kalyan (w)	Truck	100	800

After executing the system it was finally observed , how the vehicles toll tax was automatically detected by the above mentioned process. Finally, the database processing task is done through SQL, were we displayed the number plate image along with the ID genertaed through RFID which in turns detectes the Name ,Address,vehicle type, tax amount and finally the balance left.If in case the balance is low, the buzzer connected to the system goes high and the sound is produced indicating the owner to manually pay the Tax.

CONCLUSION:

By the realization of the above proposed system we can make the Toll Tax collection system more efficient and can reduce the traffic logging on the highways. This system will save a lot of precious time of the driver, passengers as well as of the tax collection authorities. By the realization of the above proposed system one can learn many aspects of a digital electronics circuit. This will give the complete knowledge of designing microcontroller based system and developing embedded software .We will also learn the software development strategies and various programming techniques for PC based applications.

REFERENCES

[1] N. Gabriel, I. Mitraszewska, K. Tomasz, "The Polish Pilot Project of Automatic Toll Collection System", Proceedings of the 6th International Scientific Conference TRANSBALTICA, 2009
.

[2] Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins "Digital image processing using MATLAB",Prentice Hall, 2003

[3] D. M. Grimes and T. O. Jones, ―Automotive radar: A brief review Proc. IEEE, vol. 62, no. 6, pp. 804–822, Jun. 1974.

[4] Wojciech Bieniecki, Szymon Grabowski and Wojciech Rozenberg "Image Pre-processing for Improving OCR Accuracy", MEMSTECH'2007, IEEE 2007

[5]International Journal of Electrical and Electronics Research ISSN 2348-6988 (online)
Vol. 2, Issue 2, pp: (67-72), Month: April - June 2014.

[6]Journal of Theoretical and Applied Information Technology © 2005 – 2010JATIT&L